ELECTRICAL REVIEW
AND
WESTERN ELECTRICIAN

VOL. LVI, No. 17. CHICAGO, SATURDAY, APRIL 23, 1910. ISSUED WEEKLY.

BY THE
ELECTRICAL REVIEW PUBLISHING COMPANY
CHARLES W. PRICE, President and Treasurer.
A. A. GRAY, General Manager. H. S. TUTHILL, Secretary.
C. W. FORBRICH, Assistant Treasurer.

PUBLICATION OFFICE: MARQUETTE BUILDING, CHICAGO

EASTERN DEPARTMENT . . . . . 13 Park Row, New York.
E. E. Wood.
EUROPEAN OFFICE . . . . . 42 Old Broad Street, London, E. C.
Henry W. Hall.

Editors:
CHARLES W. PRICE. A. A. GRAY. F. H. BERNHARD.
Associate Editors:
H. FARRINGTON. H. EHRLICH. C. H. SEAVER.

SUBSCRIPTIONS.

One Year, United States $3.00
One Year, Canada 4.00
One Year, Foreign Countries 6.00
Single Copy, 10 cents. Back numbers, beyond one month, each . .25

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

CONTENTS.

EDITORIALS:
Public Utility Policies at Commission Hearings 825
One Method of Smoke Abatement 826
Boiler Economies 827
Reducing Overtime Costs in Industrial Establishments 827
The Telephone in the Sick Room 827
Dinner for Prominent Men in Western Union and Bell Companies 828
Utilities Board for Maryland 828
First Pennsylvania Electric Train 828
Frank Julian Sprague 829
Proposed One Cent Fare 830
The Illuminating Engineering Society—April Meeting of the New York Section 830
Indianapolis Telephone and New Long Distance Telephone Company Elect Officers 830
The 6,000 Kilowatt Turbo-Generator Set at Manchester, England 831
Debate at Cornell University 836
No New Stock for American Telephone 836
Education for Leadership in Electrical Engineering 837
St. Louis & Kansas City Electric Plans 839
Commission News from New York 840
Chicago Electric Club 840
Waterpower Rates in Wisconsin 841
Electrical Exports for February 841
CENTRAL STATION PRACTICE:
Water Power Development at Keokuk and Hamilton 842
Central-Station Stimulaation 843
Price of Electricity 844
An Instance of Economy of Steam Power 846
Economy of Supplying Outlying City Districts with Polyphase Current 846
ELECTRIC LIGHTING AND ILLUMINATING ENGINEERING:
Theoretical Notes on Interior Lighting 847
Electricity Displaces High-Pressure Gas Illuminating on English Skating Rink 849
Chicago Section of the Illuminating Engineering Society 849
Change in National Electric Code 849
TELEPHONY, TELEGRAPHY AND WIRELESS:
Cable Work 850
Anticipation of Trouble in Telephony 851
Method of Simultaneously Starting Several Arcs for Signaling in Wireless Telegraphy 852
A Very Sensitive Electrolytic Detector Operating Without Auxiliary Electromotive Force 852
INDUSTRIAL POWER:
The Depreciation and Maintenance of Electrical Equipment 853
Short Circuiting of Turbo-Alternators 856
Gas-Engine-Driven Electric Installation for Australian Mine 856
Electric Power in Brazilian Mills 856
FINANCIAL REPORTS OF ELECTRICAL COMPANIES 857
INDUSTRIAL SECTION:
First Installation of 500-Watt Mazda Lamps 858
Fireboat for Duluth & Iron Range Railway Company 858
A New System of Lead Jointing 859
Producer-Gas-Driven Alternator Set 860
Grounding of Switches 860
Physics Club of Philadelphia 860
An English Gas-Driven Generator Set 860
Standards for Ornamental Street Lighting 861
Siemens "Onewatt" Drawn-Filament Tungsten Lamp 861
New Type of Ignition for Automobile Motors 863
CURRENT ELECTRICAL NEWS 863
RECORD OF ELECTRICAL PATENTS 870

Copyright, 1910, by the Electrical Review Publishing Company.

PUBLIC UTILITY POLICIES AT COMMISSION HEARINGS.

The growth of the commission method of corporate supervision suggests the wisdom of paying closer attention to the conduct of cases before such tribunals, in order that public utility companies may appear to the best advantage during hearings. In many commonwealths this form of supervision is so new to the electric and gas companies that it is not surprising that the presentation of evidence, information and argument tends to be too fragmentary for the best results. From the point of view of the company which has never been subjected to any regulation other than that contained within the current statutes, it is often most trying and burdensome to be obliged to appear before a newly created tribunal to defend its rates, service or security issues. In order that a commission may pass upon such matters it is necessary for it to examine a very large number of figures and data bearing upon the conduct of the company's affairs for perhaps several years back, and often it means a substantial expenditure of time and money for a company to assemble the information necessary.

Any other policy than complete willingness to present all necessary data before a regulating tribunal is doomed to failure. This does not mean that competitors are to be allowed to visit the plant and office and examine all manner of books and papers at their own sweet will, or that the opponents of a company are to have the right to employ engineering experts who are to be turned loose among the company's documents with full authority to make out their case ad libitum. Giving a commission all the information it desires is another matter, and in practically all cases that we have observed this course has been regarded with due confidence by the supervising body. Of course, all matter presented at public hearings has become public property de facto, and yet companies not seldom attempt to restrain such information from being thrown open to the public even after filing with the board sitting upon the case. As a matter of fact, it is usually the case that a commission cannot receive any information in the course of a public hearing which it can keep out of its public files, and in the best practice not only the exhibits, but the full stenographic record and typewritten testimony of the hearings, are filed for public examination at any time by all parties interested.

These considerations point to the permanent satisfaction of such a conduct of affairs that a company has nothing to conceal, and it is unquestionable that public utility organizations who recognize the value of publicity and who are doing their best to give good service at rates that are not extortionate, while still furnishing a reasonable return, find the presentation of data at hearings an excellent opportunity to put their cases before the great consuming public. Where most of the weakness lies is an inadequate preparation of the case and in the failure to submit sufficiently complete answers to the inquiries of the members of the reviewing board. This cannot be remedied in a single year in states where commission control is a new experience, but an open-minded policy will eventually do much to establish successful relations.

Failure to bring engineering and operating officials to hearings in connection with security issues may result in imperfect presentation of evidence; the absence of detailed statements of expenditures leading to indebtedness which must be liquidated by new stock or bond issues often causes extensive corporate embarrassment; evasion of questions from the commission promotes nothing but more searching inquiries; lack of technical information concerning the sizes and makes of machinery, and the absence of detailed evidence illustrating construction disbursements on a basis which can be readily checked by the board all hamper the early settlement of petitions. In well-conducted cases before commissions there has been a noteworthy increase lately in the volume of technical evidence presented in support of corporate points of view, and the quality of such testimony is almost always such as to command the respect of the boards with whose workings we are most acquainted. It is not necessary for a company to bring its detailed expense vouchers into the great majority of cases, but where a new power station, for instance, has been erected upon funds borrowed in the form of short-time notes, and where a company desires to issue securities to pay this indebtedness, it is fundamentally desirable to be able to present the expenditures in itemized form, giving data of real engineering value upon the actual cost of the work. Sometimes a company attempts to give merely the outlines of this information and to depend upon its annual returns to the commission for their interpretation, but this practice is objectionable since it is almost always the fact that commissions require special information of the most recent date in dealing with financial questions, and it is well to have all the points of importance assembled in one group of sheets. It begins to look, in fact, as if a corporation diary would be desirable in the dealings which the future is sure to require companies to enter into with state boards.

The above matters are not discussed in any spirit of criticism of corporate administration, but simply with the idea of facilitating business before state commissions by a few suggestions which have grown out of repeated observation of causes of lost effort and delays in closing up business of this kind. The financial man in a large company does not always realize the importance of engineering information in conducting these cases, and on the other hand, the corporate accounting system is not always equal to the emergency. However great the burden of submitting a vast amount of detailed information to a public board, when requested, the fact remains that such a course is the ultimate safeguard of the company against decisions based upon inaccurate or inadequate information. For in the long run an important part of a commission's duty is the protection of the company no less than the public.

ONE METHOD OF SMOKE ABATEMENT.

Although the smoke nuisance is not so pronounced in American cities as in European cities where the use of open fireplaces is still almost universal, it is nevertheless of sufficient import to warrant practical suggestions being put forth for its reduction. Early morning in an English town, for instance, is always heralded by the clouds of black smoke which come pouring forth from the chimney stacks of the houses when the kitchen fires are lighted to warm the house and to cook the morning meal, and the smoke is continuously in evidence until the fires are allowed to die out at night time. Hot-water and steam heating, and gas ranges for cooking, are more used in America than open fireplaces, but heating boilers make smoke, and both smoke and gas fumes are objectionable and insanitary.

The Englishman likes his open fireplace, largely because of its cheeriness, and by the same token cordially detests the steam or hot-water radiator because of its lack of this quality and also because it not only tends unduly to dry the air in the house, but also does not assist in ventilation as does the open fire with its continual draft up the chimney. And it must be admitted that there is reason in all this.

Why not then utilize some means which combines the convenience of steam or hot-water heating with the obvious advantages of the visible open fire? The answer to this query is the luminous electric radiator. With this modern device there is no boiler to belch forth its smoke to hang as a pall over the landscape, no attendance is required, no dust or dirt is made, and drying of the air is largely avoided. Its portability is an added point in its favor, and with an electric fan or ventilator as auxiliary, renewal of the vitiated air in the room is easily effected. The luminous radiator is quite as cheerful as the open fireplace and is certainly much more of an ornament from an artistic standpoint. Add to this electric cooking appliances, and the boiler fire, and the coal or gas range can be forever abolished from our homes.

There is one drawback, perhaps, to the utilization of these devices, and that is their cost of operation, but even with prices as they are at present there are many offsets

to the apparent cost. Any electric appliance can be used just when it is needed, and when it has fulfilled its purpose for the time being the current can be turned off and that is all there is to it. A boiler or stove fire is not so flexible. Moreover, the absence of dust and dirt lengthens the life of the furnishings, etc. But the time is near at hand when the price of electric current for heating and cooking will be materially reduced, and the use of electricity for these purposes will be greatly increased, much to the benefit of the load factor of the central station. This has already been done in Portsmouth, England, where the charge for electricity for heating and cooking is now one cent per kilowatt-hour, and the load and load-factor of the Portsmouth generating station are going up by leaps and bounds, with very little increase in operating costs.

Thus the ultimate solution of the smoke problem would seem to be the centralization of electrical distribution and the utilization of electricity for heating and cooking in the household. When this is done, and it is not by any means visionary, and when the electric-motor drive displaces entirely the obsolescent mechanical drive in our shops and factories, then and only then will the smoke question become a forgotten evil.

BOILER ECONOMIES.

That the steam boiler, considered thermodynamically, is an inefficient piece of apparatus, is a well-known fact. It is an excellent boiler indeed that will generate over ten pounds of steam per pound of coal, which corresponds to an efficiency of somewhat over seventy per cent for coal of good quality. Taking the boiler and engine together, the figures are even more startling, for the best of plants will not give a much greater efficiency than sixteen or seventeen per cent, while in many cases the efficiency works out to less than two per cent.

Methods of increasing these figures are always of interest to central-station operators, and several of these have been discussed from time to time in these columns. One important cause of loss of efficiency was recently pointed out by Mr. H. H. Vaughan in a paper read before the Western Canada Railway Club. The boiler referred to in this case belonged to a locomotive tested at the St. Louis Exposition in 1904. Tests showed that the principal cause of inefficiency was due to loss of fuel unburnt when the boiler was unduly forced. When the fuel burnt amounted to twenty-five pounds per square foot of grate area per hour this loss amounted to five per cent, while for a combustion of 120 pounds the loss increased to thirty-five per cent of the total fuel fired.

The moral in this case is obviously that the rate of combustion of a steam boiler should be kept within the limits for which the boiler is originally designed if efficient working is desired, and that high-duty boilers should be designed to give greater rates of evaporation rather than greater rates of combustion. Also, when the duty of a boiler is to be increased, it is desirable, from the standpoint of economical working, to redesign the heating surface rather than to force the boiler above its normal capacity.

REDUCING OVERTIME COSTS.

One of the most serious items of expense in individual establishments is the cost of working one or more departments overtime. Most firms pay extra to the help for working after regular hours, but this usually is a minor item compared with the increased cost of running the machinery when mechanical drive is employed.

Obviously when one department out of several in an industrial works is running while the rest are shut down, the engine is operating on a poor load factor and therefore inefficiently. Moreover the friction losses of line shafting consume a far greater percentage of the total power than when the whole of the shops are in operation. All of this extra cost due to friction and poor load factor can be eliminated entirely by the substitution of electric motor drive, and a still further saving is also effected in view of the fact that the presence of the engine and boiler room staffs is no longer required.

This question of reducing costs on overtime work in industrial establishments should prove one of the most telling arguments of the central-station solicitor and the electric-motor salesman.

THE TELEPHONE IN THE SICK ROOM.

Few people who have experienced the convenience of a telephone in the sick room realize the extent to which a judicious installation can lighten the burdens of illness. In many kinds of physical ailment absolute quiet is of course essential, and even the ringing of a telephone bell fifty feet away from the sick chamber cannot be tolerated. There are many other cases, however, where a telephone at the bedside does more to promote the peace of mind of the invalid than almost any other material device, and especially during the convalescent period.

A recent instance is typical. The manager of the district office of a large electrical equipment manufacturing house injured his hip in an accident, and had to lie for a protracted period in a plaster cast. Locomotion was simply out of the question, and as is often the case the accident happened at a time when many important propositions were being pushed to a successful conclusion. An extension telephone was installed at the bedside, and by its means the master mind of the office for weeks kept in closest touch with affairs, advising and directing his subordinates without the loss of time which would have accompanied personal trips several times per week to his residence. Thus the stream of orders was not dammed by the illness of the district chief, and incidentally the social intercourse facilitated recovery by reduction of tedium to the minimum.

Dinner for Prominent Men in Western Union and Bell Companies.

The officers of the American Telephone and Telegraph Company tendered on April 19 a dinner to the officers of the Western Union and Bell companies at the Hotel Astor, New York city.

About sixty persons were present, among them U. N. Bethell, president of the New York Telephone Company, who acted as toastmaster; Theodore N. Vail, president of the American Telephone and Telegraph Company; Colonel R. C. Clowry, president of the Western Union; H. B. Thayer, vice-president of the American Telephone and Telegraph Company; B. E. Sunny, president of the Chicago Telephone Company; G. V. Leverett, general counsel of the American Telephone and Telegraph Company; Belvidere Brooks, general manager of the Western Union; H. F. Thurber, vice-president of the New York Telephone Company; H. A. Halligan, vice-president of the Western Electric Company; H. D. Estabrook, attorney of the Western Union; E. Y. Gallagher, auditor of the Western Union; C. G. Du Bois, controller of the American Telephone and Telegraph Company; C. H. Wilson, general superintendent of the American Telephone and Telegraph Company; J. B. Van Every, Thomas F. Clarke, G. W. E. Atkins and A. R. Brewer, all Western Union officials.

Utility Board in Maryland.

The Public Utilities Commission, of Maryland, created by the recent Legislature, will be composed of three members who will have jurisdiction over all public utilities in the state, including telephones, street railways lighting plants, etc.

The Commission has power to determine rates to be charged to each public corporation subject to the act. The rates are required by the act itself to be just and reasonable, and the Commission is vested with full and plenary powers to conduct investigations in order to enable it to ascertain what rates in the case of each particular public service corporation are just and reasonable.

First Pennsylvania Electric Train.

The Pennsylvania Railroad recently operated the first electric train through the tunnels under Manhattan Island and East River. The train, made up of six construction cars and an electric locomotive, ran from the station in New York to the Thompson Avenue viaduct in Sunnyside Yard, Long Island City.

The extensive work on the electrifications and signaling in the tunnels between Long Island and Jersey City is being pushed with all possible speed. The signal bridges have been erected on the Hackensack meadows section, and the third rail is now being laid. The third rail work and the track ballasting in both the North and East River tunnels are practically completed.

Commercial Relations of the United States.

The annual report of American consular officers, embraced in Commercial Relations of the United States for the calendar year 1908, are comprised in two volumes. The first includes Europe and the second the balance of the world. These publications may now be secured by the business public from the Bureau of Manufactures, Washington, D. C. The work includes a review of the foreign trade of each country, and of the various cities and districts; industrial progress and conditions; the declared exports of merchandise to the United States; the opportunity for the extension of the American export trade, etc.

Set-Screw Connectors to Be Prohibited.

Commissioner Thompson of the Department of Water Supply, Gas and Electricity of New York city, announces that the use of set-screw connectors for outlet boxes and other conduit and armored cable fittings will be prohibited throughout the city after June 1, 1910. This prohibition is not, however, to exclude the set screw which is employed for securing the fitting to the gas outlet.

Toronto Officials to Visit Subway.

A visit to Boston and Philadelphia is to be made soon by Alderman McCarthy and City Engineer Rust of Toronto to secure advice on the question of a subway and surface system of street railways.

General Electric.

Construction work on the General Electric Company's new plant to be situated at Erie, Pa., will be begun shortly.

The General Electric business increases about ten per cent on the average each year and the new plant is desired to take care of the company's growth for some years to come. The several units will be added as occasion demands and eventually the plant will give employment to about 20,000 men.

New Johns Hopkins Plans.

A committee has been organized at Johns Hopkins University for the purpose of collecting $2,000,000 to move the university to its new location in Homewood and to establish a school of higher engineering.

It is expected that technical graduates will enter this school to take up research work and to develop new processes of manufacture.

New Engineering Building for North Carolina.

Work is to be begun at once on the erection of the engineering building at the Agricultural and Mechanical College, which is to be built of re-inforced concrete and to be three stories in height.

The plans for the building were made by Frank B. Simpson, architect, of Raleigh, and the building is to be occupied by the departments of civil and electrical engineering and the chemical department of the Agricultural and Mechanical College.

San Francisco Electrical Exposition Postponed.

At a meeting of the exhibition committee of the San Francisco Electrical Show, held April 16, it was unanimously decided to postpone the opening of the exposition until August 20.

Street Lighting.

A recent article in the London *Electrician* quotes A. Denman Jones, manager of the Jandus Electric Company, of Manchester, Eng., as saying that the street-lighting battle of the future will be waged between the inclosed flame arc and high-pressure gas—that is in England.

The $500,000 powerhouse which is to be built at Albany, N. Y., to supply the state buildings with light, heat and power, will be a model plant in every way. State Architect Ware has been authorized to consult with Nygren, Tenney & White, of New York, regarding the plan.

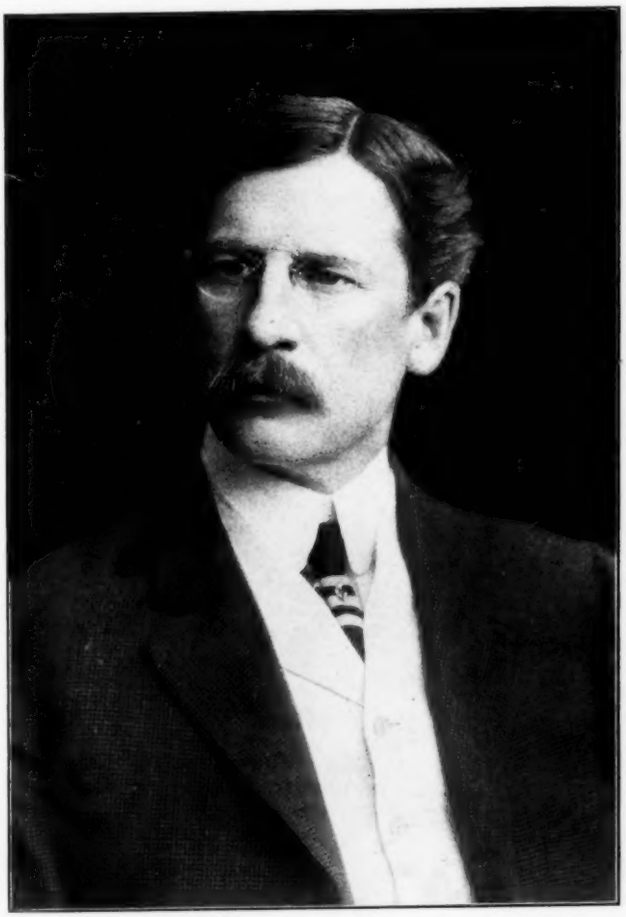
Frank Julian Sprague.

When we think or write about men who have accomplished great results in the face of almost insuperable difficulties; men who helped to usher in the advent of practical commercial electrical engineering; men who exercised their genius to tame this most potent element and who effected the means by which electricity has been harnessed for the use of mankind, we naturally have uppermost in our minds Frank Julian Sprague.

No one looking at Mr. Sprague today would imagine that nearly twenty-five years ago he stood on his own electric car which had been put into service by a full-fledged corporation and knocked the sleet off the trolley wire with a broom handle so that the experiment might continue. Nor can one well believe that he hitched up a pair of mules to drag the car back to the station when the "juice had given out"; but this is history, and Frank J. Sprague has had a large part in the making of electrical history.

Having successfully placed his motor upon the low-tension incandescent lamp circuit of the Edison Company, he and his associates turned longing eyes upon the electric railway field. His first contract was soon signed with the Union Passenger Railway at Richmond, Va., for forty cars, thirty of which were to be in use at one time. This contract called for as many electric cars as were then in service in the country, and the grades in Richmond were believed to be beyond the climbing capacity of an electric vehicle. After encountering experimental difficulties and disasters that would have tried the faith of any body of men less loyal to a cause, the road was opened for regular service about February 1, 1888. A little later the sight at Richmond of twenty-two motormen starting up their cars, one after the other as rapidly as headway could be gained, decided those financially interested upon the electrification of the West End Railroad of Boston, sealing the fate, for that installation, of the proposed cable railway line, and endorsing Mr. Sprague's advocacy of the use of motors upon each car in contrast to the use of electric locomotives, the use of which had reached a promising development. His later introduction of the multiple-unit system of control crowned his work in this direction.

He has always been a direct-current man, and notwithstanding the notable advances made in alternating-current electrification of railways, he is the ardent advocate of the direct-current system, and his achievements in this direction have been no less noteworthy than his logic and eloquence in championing his ideas.



FRANK JULIAN SPRAGUE,
A Leading Electrical Engineer and a Pioneer in the Development of the Electric Railway.

Frank Julian Sprague was born at Milford, Conn., July 25, 1857. He was a son of David Cummings and Frances Julia Sprague. He was graduated from the United States Naval Academy in 1878. He was a member of the jury of the Crystal Palace Exposition in 1882, and resigned from the naval service in 1883, becoming an assistant to Thomas A. Edison. In 1884 he founded the Sprague Electric Railway and Motor Company, through the agency of which he carried on the memorable installation at Richmond. Later he organized the Sprague Electric Elevator Company and the Sprague Electric Company. He is a pioneer in electric railway development and in the introduction of the high speed electric elevator. He invented the multiple-unit system of control for electric railways, installing the first practicable system on the south side elevated railway in Chicago in the face of great discouragement and despite the assurance of many engineers that he was trying to accomplish an impossible feat.

He was awarded the gold medal at the Paris Exposition in 1889; the Elliott Cresson medal by the Franklin Institute in 1904; the grand prize at the St. Louis Exposition in 1904 for invention and development in electric railways.

He has been consulting engineer to nearly all of the great electrification projects both in this country and abroad, his most recent notable achievement being in connection with the electrification of the Sierra Nevada division of the Cascade Railway.

He is a past-president of the American Institute of Electrical Engineers, a member of the Institution of Electrical Engineers of Great Britain; he is a member of the American and British associations of civil engineers; a past president of the New York Electrical Society; an associate member of the Society of Naval Architects, and a member of the University, Engineers and Railway clubs. He has contributed liberally to the literature of various topics bearing upon the practical utilization of electricity and his papers on the electrification of railways are classic. Personally he is one of the most genial of men; he is a ready and forceful speaker, and his keen wit and repartee has enlightened many a dull discussion.

Proposed One-Cent Fare.

In order that the poor of New York city may be able to visit the parks in summer, Tenement Commissioner Murphy has proposed that the empty cars resulting from the morning and night rushes be made use of.

Mr. Murphy said in outlining his scheme: "During the morning hours the great crush of traffic is on downtown trains. There are no facilities for storing empty trains in the lower terminals of the elevated lines, and hence the cars that have carried the crowds downtown in the rush hour have to be sent back uptown for storage until again needed in the evening. They go uptown comparatively empty.

"The same cars are sent downtown again in the evening, to take the crowds home, practically in the same condition. I suggest that the Interborough sell round-trip tickets to Bronx Park between the hours of eight and ten in the morning for poor women and children for two cents.

"These passengers will go uptown on the now empty trains, returning to the yards in the upper terminals, and will be carried back home on the same trains when they are sent down to take the crowds at the uptown rush hour in the evening.

The Illuminating Engineering Society —April Meeting of the New York Section.

The custom of having two papers at the monthly meeting was continued at the one held April 14 at the Engineering Societies Building, New York, N. Y., by the New York Section of the Illuminating Engineering Society.

The section chairman, E. L. Elliott, presided and first called Bassett Jones, Jr., who read his paper on "Finite Surface Light Sources." In this paper, which was of a mathematical nature, it was shown that sources of any shape, such as hemispherical, semi-ellipsoidal, or semicylindrical may be treated as plane surface sources having an area equal to the aperture of the actual source and a flux per unit area equal to the flux per unit area of the actual source.

The second paper on "The Relation of Fixture Designs to Modern Illuminating Engineering Practice," by L. R. Hopton and H. E. Watkins was read by the former. The subject was handled in the broadest possible way, and certain matters affecting the design of lighting fixtures, previously left almost untouched in the *Transactions* of the society, were taken up carefully and in considerable detail. The paper was illustrated profusely and artistically.

An interesting point was brought out by Mr. Jones, who stated that in several monumental buildings the architects had literally planned their rooms around the lighting. The papers were also discussed by Messrs. Marshal, Elliott, McGuire, Wohlauer and Spencer.

At the May meeting Messrs. Sharp and Miller will present a paper on Photometric Measurements and C. O. Bond on Standards of Light.

At the June meeting the local section officers are to be elected for the ensuing year.

Tri-Borough Rapid Transit Hearings.

Public hearings on the draft forms of contracts for the building of the Tri-Borough Rapid Transit Railroad in New York city will be given by the New York Public Service Commission May 9 and 16 at 2:30 p. m. The resolution providing for the hearings, which are required by law as part of the procedure, was adopted last week.

The hearing on May 9 will be on the draft form of contract for construction, equipment and operation of the line, and the hearing on May 16 will be on the contract forms for construction of the line by sections at municipal expense.

The Tri-Borough route consists of the Broadway-Lexington Avenue line, the Canal Street line and the Broadway-Lafayette line. After approval of these contracts has been obtained advertisement will be begun for letting the contracts. Should no satisfactory bid be received for equipment, construction and operation the commission can then, with the approval of the Board of Estimate and Apportionment, let contracts for as many sections of this system as can be done with the money that is at present available for that purpose.

Five-Cent Fare Bill for New York.

Senator Schulz of New York city has introduced a bill providing for a five-cent fare law for the Boroughs of Manhattan and the Bronx. It provides that no railroad corporation owning, maintaining, operating or controlling a steam or electric road through this part of the city, with two or more stations along its route in these boroughs, shall charge more than five cents fare for carrying passengers from any station along its route in these boroughs to any other station along its route in these boroughs, upon any train which is scheduled to stop at these stations.

Indianapolis Telephone and New Long Distance Telephone Elect Officers.

A meeting of the stockholders of the Indianapolis Telephone Company and the New Long Distance Telephone Company was held at Indianapolis, April 13, and the following directors were elected for both companies: F. W. Stevens and F. H. McKnight, of the firm of J. P. Morgan & Company, of New York city; William Fortune, John B. Elam, Louis Holweg, F. D. Stalnaker, John H. Holliday, John N. Carey and A. A. Wilkinson. The directors in turn elected the following officers: President William Fortune; vice-president, Louis Hollweg; secretary-treasurer, Charles S. Narton.

The New Long Distance company has added 216 miles of No. 10 copper circuit to its system during the past year. The directors have authorized the company to go into the market and buy material and equipment and proceed to install a special underground toll cable system through Indianapolis and to make other improvements. S.

Ft. Wayne Section of the American Institute of Electrical Engineers.

The Ft. Wayne Section of the American Institute of Electrical Engineers was addressed by J. A. Snook, of the Switchboard Engineering Department of the Ft. Wayne Electric Works, upon "Regulation of Switchboard Instruments." The address proved very interesting and instructive to the members and visitors present. Mr. Snook proved that he was thoroughly acquainted with his subject. S.

Cheap Power for Ontario.

According to Consul Felix S. S. Johnson the chairman of the Canadian Hydro-Electric Power Commission has stated that it would soon start to arrange for a supply of cheap power for eastern Ontario, including Kingston, Belleville, and Brockville.

The 6,000-Kilowatt Turbo-Generator Set at Manchester, England.

Description of the Plant, and Records of Tests Showing Remarkable Efficiencies.

It has previously been pointed out in these columns that the steam turbine possesses two great advantages over the reciprocating engine, viz., its capability of utilizing the expansion of steam in the lowest obtainable absolute pressures, and its practicability of being made in extremely large units. Reciprocating engines, it may be noted, have about reached their limit of size, for it is now a matter of common knowledge that one of the chief reasons that led to the use of the turbine in the record-breaking Cunarders, *Mauretania* and *Lusitania*, was the difficulty of designing reciprocating engines of sufficient size to meet the requirements of these vessels.

There is no doubt as to the superiority in economy of the large steam turbine, under proper operating conditions, over the reciprocating steam engine of equal power, and many other advantages of the turbine make it certain that no other known form of steam engine will be used for electric generating stations where the output is of even moderate amount.

Although by no means the largest turbo set that has been built, the 6,000-kilowatt Howden (Zoelly)-Siemens turbo-generator at the Stuart Street electricity supply station of the City Electrical Department at Manchester, England, is a machine of considerable proportions and possesses many features of unusual interest. This turbo-generator set was installed last year, and since the early part of September has been running under full load for about eighteen hours a day. By the courtesy of S. L. Pearce, chief engineer of the Manchester Corporation Electricity Works, we are able to publish several interesting photographs and diagrams of this installation, and the results of some recent tests which give a steam consumption that makes a better showing than was expected by the most sanguine and that is even less than the very satisfactory figure that was obtained with the 5,000-kilowatt Willans-Siemens set at the same station, and which was installed in May, 1908.

The 6,000-kilowatt machine at Manchester was constructed by the firm of James Howden & Company, of Scotland Street, Glasgow, Scotland, and is said to be the largest turbine of the Zoelly type that has yet been designed, either in England or in Europe.

The Zoelly turbine, it may be noted, is a form of impulse turbine. The steam is expanded through fixed guide blades (see Fig. 7) instead of through a series of moving blades as in the Parsons and other forms of reaction turbines. Thus the velocity of the steam is utilized only in the moving blades. By this design it is claimed that a greater clearance can be employed between the rotor and the stator, and that the end thrust in the bearings is also considerably diminished. In the Manchester turbine the radial clearance is five millimetres, or about three-six-

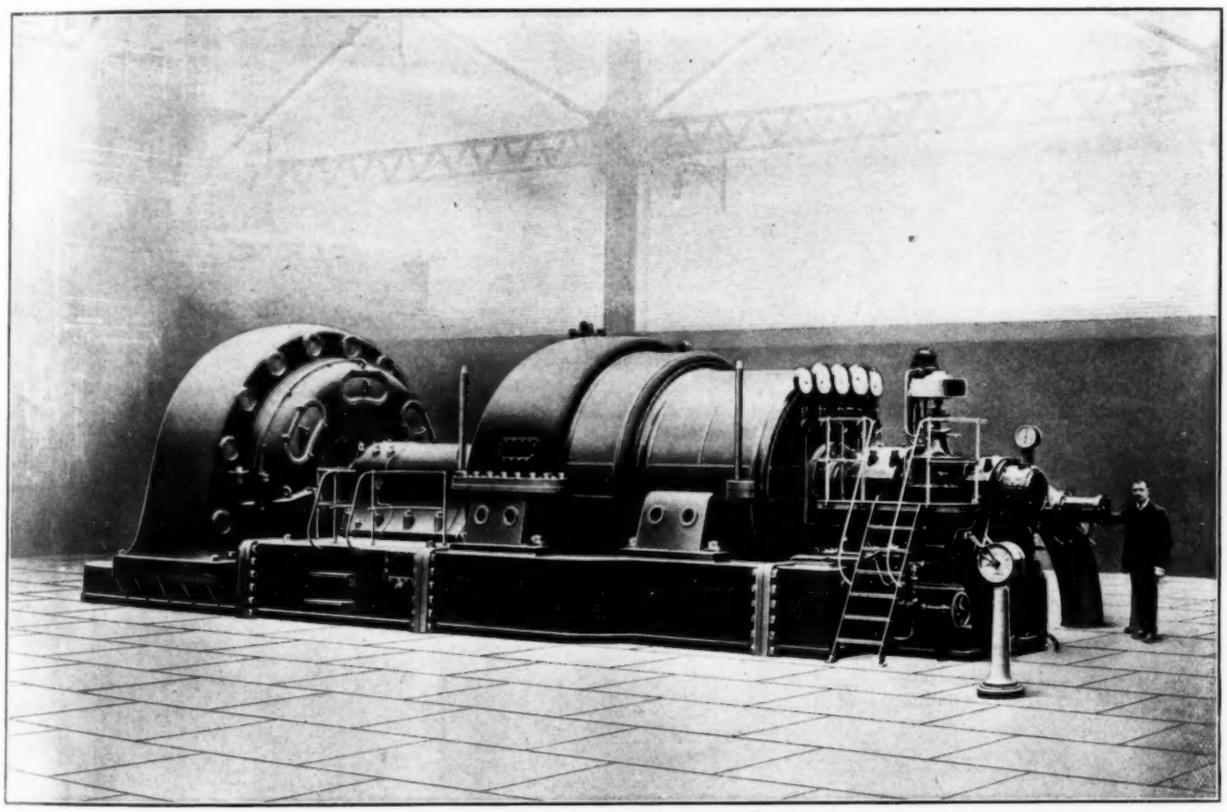


FIG. 1.—GENERAL VIEW OF 6,000-KILOWATT TURBO-ALTERNATOR.

teenths of an inch. The cylinder is divided into twenty stages in this particular instance, the steam being expanded down successively from stage to stage. The diameter of the cylinder is made larger at the low-pressure end to accommodate the increased number of blades that are necessary to handle the steam as it increases in bulk by its expansion from stage to stage. The rotor blades are secured in position by dovetailing, a method of construction which is one of the characteristic features of the Zoelly type of turbine. Increased rigidity is given to these blades by tapering them from the root to the tip, except in a few of the blades used in the high-pressure stages where the short length renders this construction unnecessary.

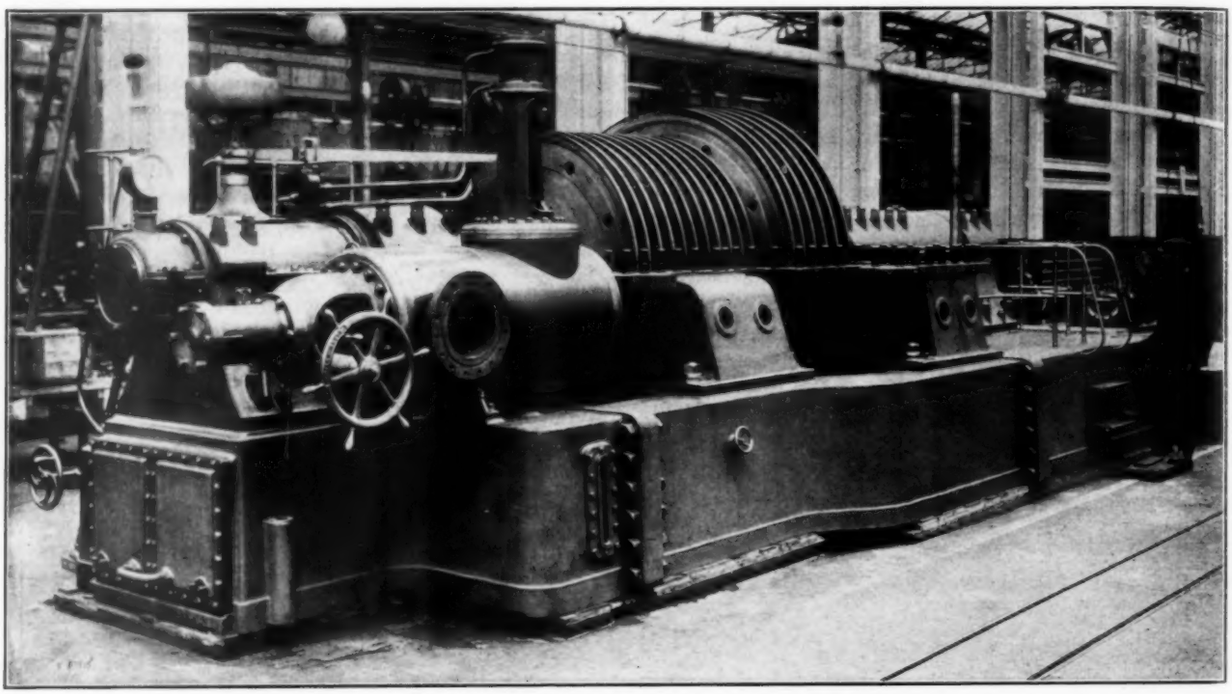


FIG. 2.—VIEW OF TURBINE WITH TOP CASING REMOVED.

Many of the dimensions of the machine may be noted by reference to the accompanying diagrams. Those of chief interest are as follows: Diameter of high-pressure turbine over blading, 67.75 inches; diameter of low-pressure turbine over blading, 90.56 inches; diameter of turbine shaft, 11.0 inches; length over all of turbo-alternator, 40.0 feet; normal speed of machine, 1,000 revolutions per minute under full load.

Although the rated performance of the machine is given as 6,000 kilowatts, the turbine will easily develop 8,000 kilowatts if required, and by using high-pressure steam in the low-pressure stages (this being effected by means of the usual by-pass arrangement), the output of the machine can be increased to as much as 10,000 kilowatts.

The following advantages are claimed by the makers for the Zoelly type of turbine:

1. The turbine has only from one-third to one-fifth the number of blades of the ordinary multistage reaction turbine for the same power and speed, and the average velocity of the steam being

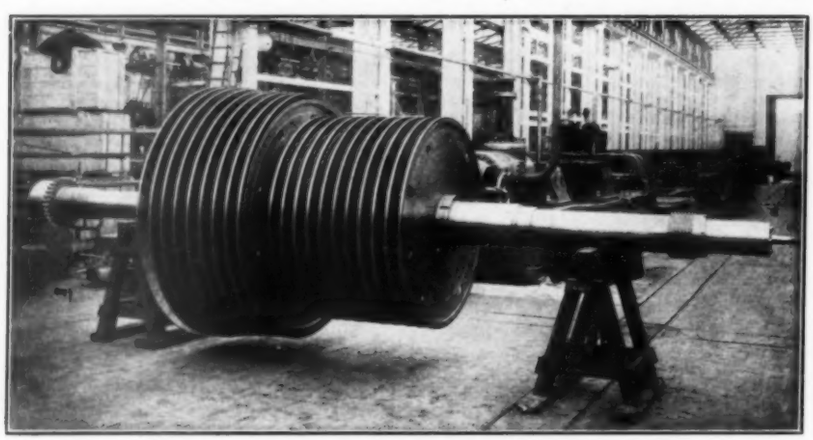


FIG. 3.—THE COMPLETE ROTOR.

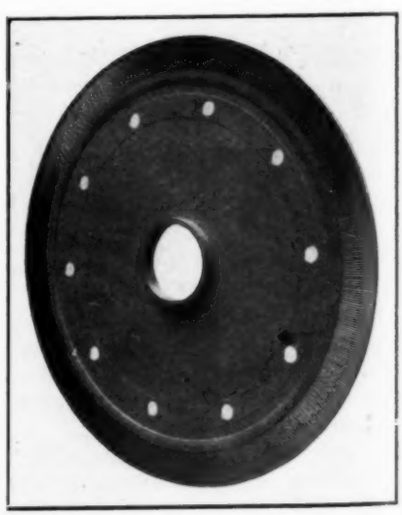


FIG. 4.—A ROTOR WHEEL.

low, the wear on the blades is practically negligible.

2. There is ample clearance between all the moving and stationary parts, and no adjustment is necessary either in the thrust or the main bearings.

3. As the principle of the turbine entirely eliminates the axial thrust, balancing pistons are not required, and the leakage incidental to such pistons is avoided.

4. The greatest advantage can be taken of superheat, as, owing to the form of casing adopted, there is no danger of warping. The turbine is not affected by great variation of temperature, and will work quite satisfactorily with steam at a temperature as high as 700 degrees Fahrenheit.

5. The lubrication is entirely automatic, and the cost of oil is very little on account of its being used over and over again.

6. The governing is exact and instantaneous, and the speed practically remains constant under widely varying loads; as steam is not admitted in gusts, as in the case of most reaction turbines, the paralleling of alternators is very much simplified.

7. As no part of the turbine except the bearings is lubricated, the exhaust steam is pure, and may be condensed and used as feed water.

8. Each running wheel is separately balanced, and after erection the whole of the rotating system is balanced, the result being that the turbine runs dead true, no vibration whatever being perceptible.

9. The steam consumption does not

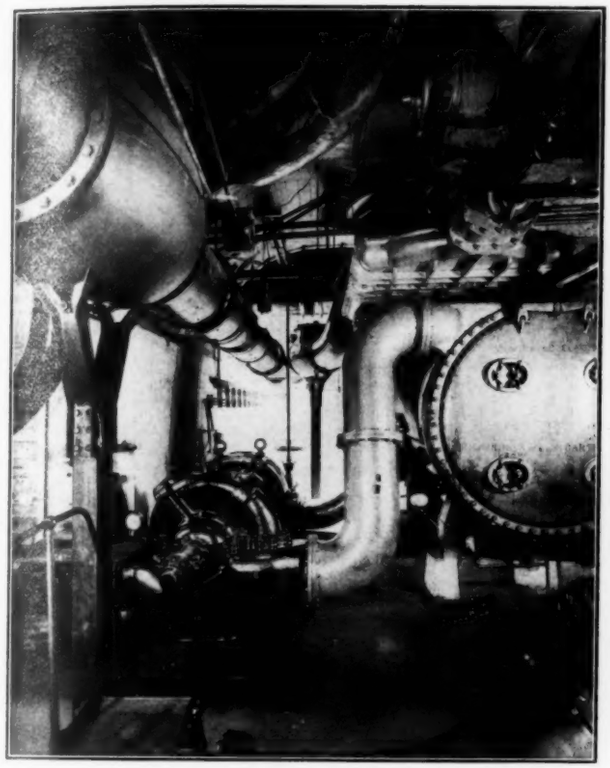


FIG. 5.—CIRCULATING PUMP AND CONDENSER.

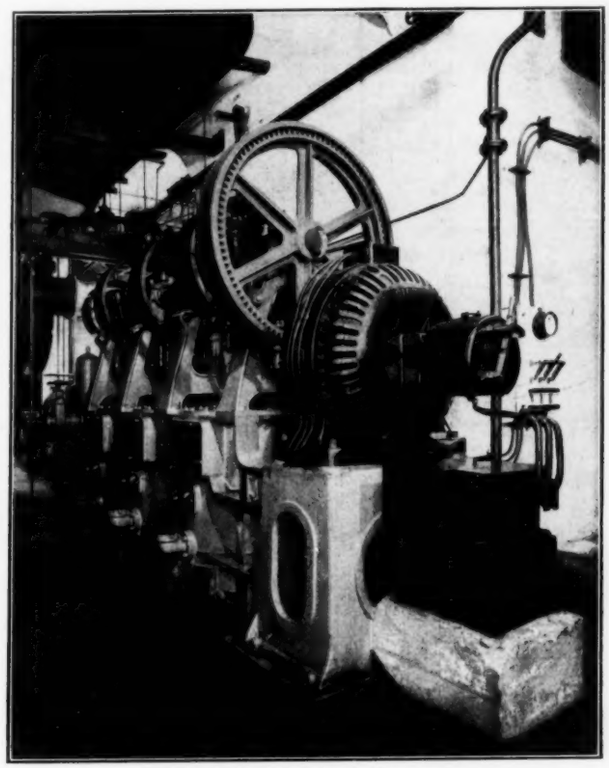


FIG. 6.—MOTOR-DRIVEN AIR PUMP.

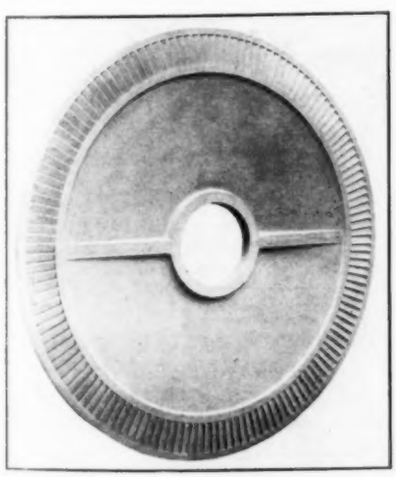


FIG. 7.—A STATOR DIAPHRAGM.

TABLE I.—Summary of Steam Consumption, etc., in pounds per kilowatt-hour. (Measured at alternator terminals, excluding auxiliaries.)

Col. I. Howden's guarantee with twenty-seven inches vacuum, total steam temperature 523 degrees Fahrenheit (140 degrees Fahrenheit superheat), barometer 30 inches.
Col. II. Howden's guarantee corrected to twenty-eight inches vacuum, total steam temperature 523 degrees Fahrenheit (140 degrees Fahrenheit superheat), barometer 30 inches.
Col. III. Actual test results with twenty-seven inches vacuum, total steam temperature 514-532 degrees Fahrenheit, barometer 30 inches.
Col. IV. Actual test results corrected to twenty-eight inches vacuum, total steam temperature 514-532 degrees Fahrenheit, barometer 30 inches.
Col. V. Results of Column IV corrected for a total steam temperature, 523 degrees Fahrenheit (140 degrees Fahrenheit superheat), barometer 30 inches.
Col. VI. Results of Column III corrected for a total steam temperature 483 degrees Fahrenheit (100 degrees Fahrenheit superheat), barometer 30 inches.
Col. VII. Alternator efficiencies.
Col. VIII. Thermodynamic efficiencies.

Cols.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Twenty-five per cent overload	15.1	14.4	14.9	14.2	14.1	15.3	96.4 per cent.	70 per cent.
Full load	14.4	13.7	14.6	13.9	13.8	15.0	96.2 per cent.	71.5 per cent.
Three-fourths load	15.4	14.6	15.0	14.3	14.4	15.6	95.1 per cent.	69.4 per cent.
One-half load	16.7	15.9	15.9	15.1	15.2	16.4	93 per cent.	67.8 per cent.
One-fourth load	19.8	18.8	17.5	16.7	16.7	18.1	87.5 per cent.	64.5 per cent.

TABLE II.

	Condenser Pumps.	Fan Motor.	Field Excitation.	Total.
Twenty-five per cent overload	360 kilowatt.	21.4 kilowatt.	22.9 kilowatt.	404.3 kilowatt.
Full load	376.2 kilowatt.		25.6 kilowatt.	401.8 kilowatt.
Three-fourths load	356.6 kilowatt.	18.0 kilowatt.	25.0 kilowatt.	399.6 kilowatt.
One-half load	333.3 kilowatt.	16.8 kilowatt.	23.3 kilowatt.	373.4 kilowatt.
One-fourth load	346.6 kilowatt.	18.1 kilowatt.	18.2 kilowatt.	382.9 kilowatt.

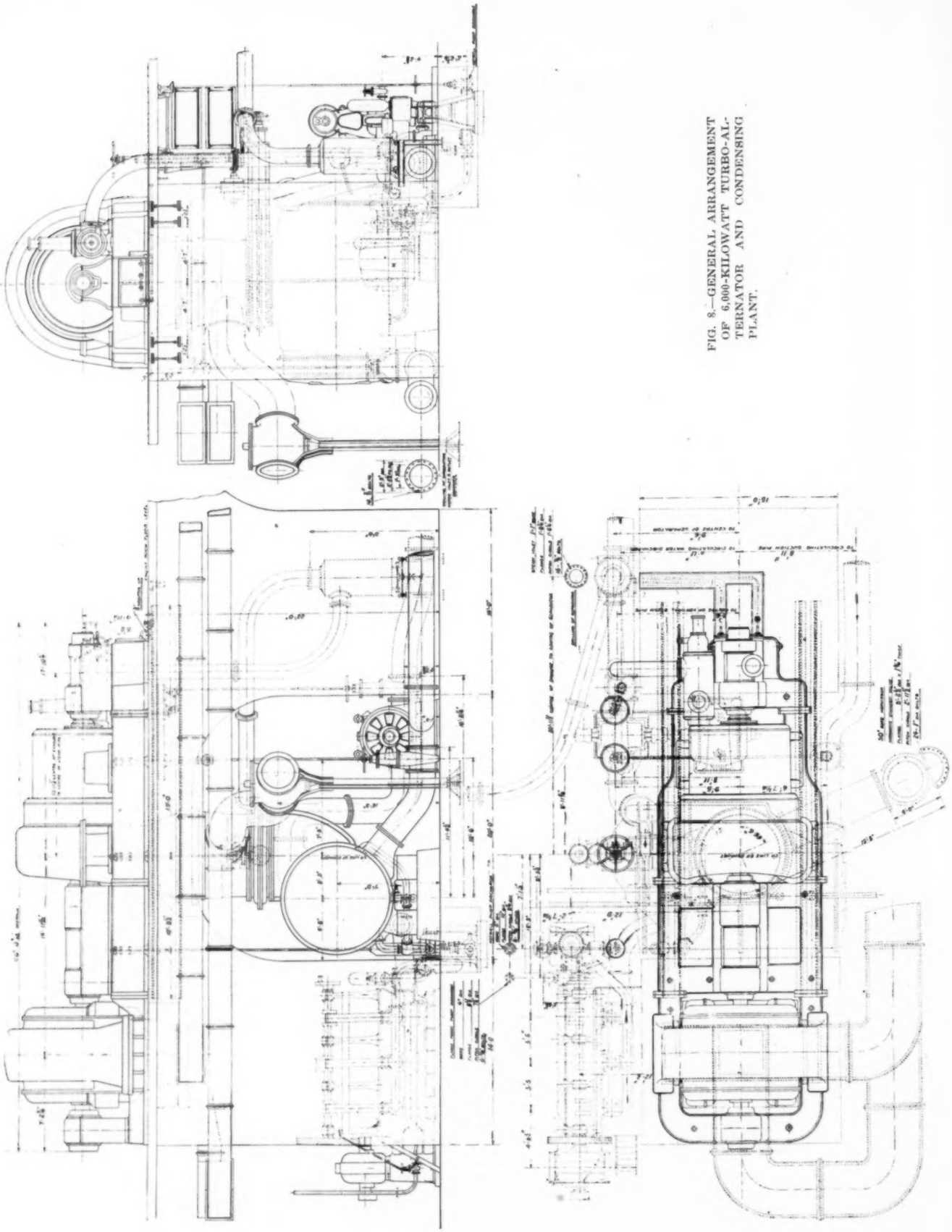


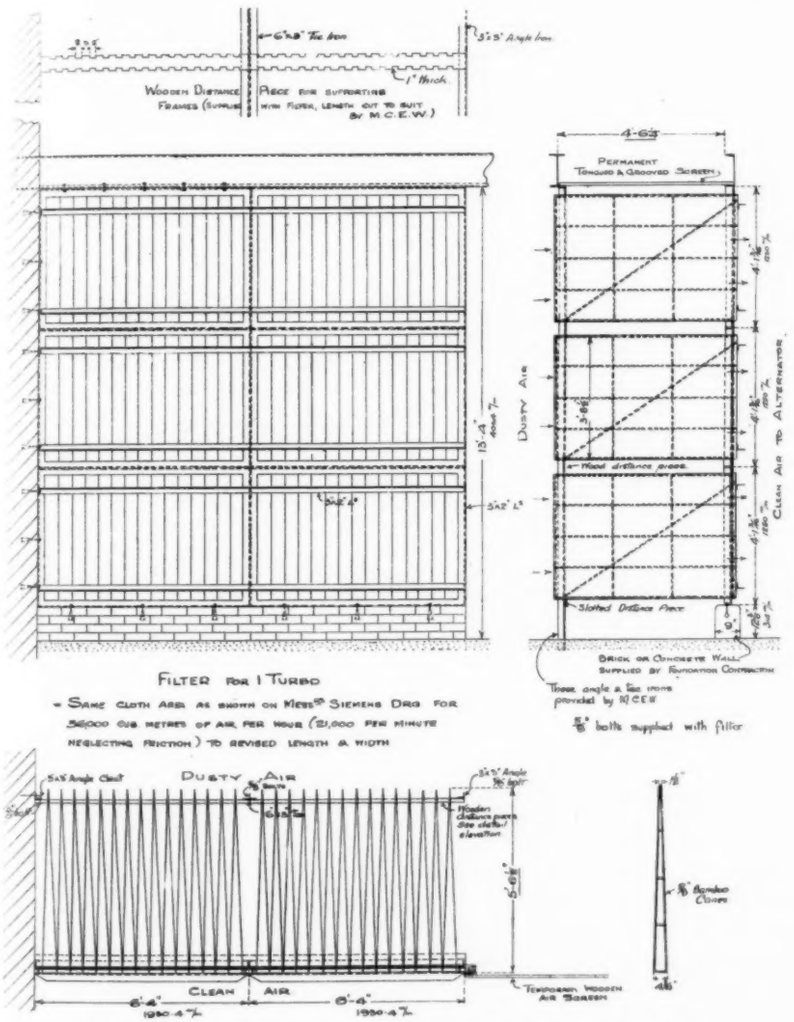
FIG. 8.—GENERAL ARRANGEMENT OF 6,000-KILOWATT TURBO-ALTERNATOR AND CONDENSING PLANT.

increase after running some time, as is the case with other types of turbines, and is independent of the attention and skill of the engine-room attendants.

Of these claims those referring to efficiency are certainly borne out by the tests which are recorded later in this article, and, up to the present at least, the machine runs with hardly any perceptible vibration. Perhaps one of the contributing causes to this latter feature is the exceptional care which has been taken in the design and construction of the foundations.

Referring to the illustrations, a complete view of the turbine and alternator is shown in Fig. 1, while Fig. 2 shows the turbine with the top cover removed, the alternator not having been added when the photograph was taken. A complete view of the rotor is given in Fig. 3, one of the separate rotor wheels being shown in Fig. 4. A set of guide blades is seen in in Fig. 7, which shows the diaphragm to be made in two halves for ease in disassembling when in position in the machine.

The alternator was made by Siemens Brothers Dynamo Works, Ltd., and is a 6,000-kilowatt fifty-cycle machine generating three-phase current at 6,500 volts between phases. A system of forced ventilation is employed, the details of the air-filtering arrangement being shown in Figs. 9 and 10. Particulars of the alternator ventilation are as follows: Fan diameter, 30.0 inches; speed of fan, 780 revolutions a minute; pressure required to draw air through cloth suction, 0.4 inches; water gauge delivery, 3.25 inches; cubic feet per minute, 13,300; horsepower of fan motor, 23.0; cloth area, 3,064 square feet; velocity through ducts, 32.0 feet per second; velocity through filter, 0.07 feet per second; normal temperature of air to alternator, 58.5 degrees Fahrenheit; normal temperature of air from alternator, 112.5 degrees Fahrenheit. The cloths are vacuum-cleaned every twenty-four hours with the turbo running continuously. They require washing once every four months in addition.


Wooden Distance Pieces for supporting Frames (Supplied with filter, length cut to suit by M.C.E.W.)
Permanent Tongued & Grooved Screen
Dusty Air
Clean Air to Alternator
Wood distance pieces
Slotted Distance Piece
Brick or Concrete Wall supplied by Foundation Contractor
Three angle & tee irons provided by M.C.E.W.
Dusty Air
Clean Air
Temporary Wooden Air Screen
Bamboo Cleats

FILTER FOR 1 TURBO

= SAME CLOTH AREA AS SHOWN ON KIESS & SIEMENS DRG FOR 36000 CUB. METRES OF AIR PER HOUR (21,000 PER MINUTE NEGLECTING FRICTION) TO REVISED LENGTH & WIDTH

⅝" baths supplied with filter

FIG. 9.—DETAILS OF VENTILATING EQUIPMENT FOR ALTERNATOR.

The general arrangement of the turbo-alternator and condensing plant is shown in Fig. 8. The condenser is a Richardson-Westgarth "Contraflo." Some changes have been made from the original design in this part of the plant, but these are of comparatively minor importance, and everything is now proving satisfactory in operation.

The circulating pump is shown in Fig. 5. This is of the De Laval centrifugal type and is driven by a 375-brake-horsepower, squirrel-cage, three-phase, Siemens motor which is run off the 400-volt station busbars. An auto-transformer is used for starting this motor.

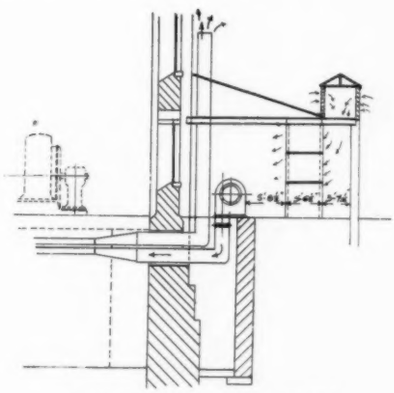


FIG. 10.—VENTILATING DUCTS.

The air pump, shown in Fig. 6, is a Richardson-Edwards three-throw pump driven by a fifty-five-brake-horsepower slip-ring motor. There is also a Greenwood & Batley (De Laval centrifugal) motor-driven hot-well pump for pumping the water from the condenser to the hot-well. Cooling towers are used for cooling the condenser water.

The tests referred to in the first part of this article were for six hours at full load and for three hours at other loads; these are given in tabular form. Table I shows: the guarantees, the actual results obtained on test, the same corrected to specified vacuum and superheat, the same corrected to twenty-seven inches vacuum of 100 degrees (Fahrenheit) of superheat, the alternator efficiencies as obtained at Siemens Brothers Dynamo Works, and the thermodynamic efficiencies of the turbine after

making allowance for the alternator efficiencies.

The figures in Table I do not include the power taken by the auxiliaries or for excitation. This information is subscribed in Table II.

It will be noted that the very fine steam-consumption figure of 13.8 pounds per kilowatt-hour was obtained (see Table I)with a vacuum of twenty-eight inches and a superheat of 140 degrees Fahrenheit. This is the same as 10.3 pounds of steam per horsepower-hour. The table also shows good efficiencies at the fractional loads.

In conclusion it may be said that the installation reflects credit not only on the designers and builders but also on the good faith and judgment of Mr. Pearce, who has frequently expressed himself in favor of the Zoelly type of turbine.

Debate at Cornell University.

An interesting scheme for stimulating the interest of electrical engineering students in their subjects and at the same time giving them experience in debate, has been evolved by A. H. Norris, professor in charge of the electrical engineering department of Cornell University.

According to the plans of Professor Norris, the members of the electrical engineering class have been divided into a number of debating teams, and each week one team is scheduled to present the affirmative and negative sides of a topic assigned for discussion.

The subjects scheduled for each week beginning with April 12 were as follows: "Resolved that the steam locomotive furnishes the best motive power for long hauls." "Resolved that the present tendency to electrify trunk line terminals is not warranted from the standpoint of economy." "Resolved that the alternating-current repulsion motor is superior to the alternating-current series motor for general traction purposes." "Resolved that the experience of the New Haven Railroad does not justify their adoption of alternating-current traction." "Resolved that the experience of Cleveland, Ohio, justifies a higher rather than a lower rate of fare." "Resolved that commission control of electrical railways, as at present practiced in this state, produces unnecessary hardships upon the railway managements."

These debates serve a number of valuable purposes: They relieve the monotony of the technical work of the course. The men are stimulated to investigate live topics and thus relate their technical knowledge to practical operating conditions. The debates teach the students to condense material into a small compass as the time allowed is limited. The practice gained in extemporaneous speaking, in which engineers are usually weak, prepares the men to take active part in association work, etc. Debates of this kind also teach the young engineer self-reliance, because the men have to champion and defend the ideas they present; they thus develop so-called engineering conviction.

No New Stock for American Telephone Stockholders.

President Vail of the American Telephone and Telegraph Company says to stockholders in a circular enclosed with dividend checks:

"In answer to the many inquiries as to the intentions of the company respecting the newly authorized increase of capital stock, you are informed that it will not be possible for the company to offer any of the new stock to shareholders during the current year, as cash resources available are sufficient for all current ordinary expenditures this year and well into the next year, and will also leave a margin sufficient to provide for all probable extraordinary expenditures.

"The work of reorganizing and readjusting the territorial lines of the associated companies will be continued, and some adjustment will be made through the exchange of the shares of this company for the shares of the associated companies. For this purpose the company now has in its treasury of its present stock issue sufficient to meet all its demands in the near future."

Weather Forecasts by Telephone.

B. Bunnemeyer, section director of the government weather bureau with headquarters at Houston, has arranged for giving daily weather forecasts and special warnings by local and long distance telephone, covering more than two-thirds of the area of the state of Texas and embracing all of the agricultural portion. This new service is free of charge to all telephone subscribers. It was placed in effect April 18. It is expected that it will prove of special benefit to the farmers. In his notice of the installation of this service, Mr. Bunnemeyer says:

"The dissemination of the forecasts and special warnings will be accomplished so that every telephone patron, whether a city or rural subscriber, will be in possession of the information within two hours after the reports have been made up and issued. The forecasts and warnings usually cover the thirty-six-hour period ending at seven o'clock in the evening of the following day. City subscribers will obtain the forecasts and warnings by calling the long distance operator at their exchange at any hour during the day after eleven in the morning. Rural subscribers will be called up about noon each day by a long ring from their operator, who will then announce the forecasts to all subscribers simultaneously. The reports will also be displayed at all exchanges receiving them in their waiting room or other appropriate place, for the benefit of the general public.

"It is difficult to estimate what this means to the rural population, whose every day affairs depend so much upon the weather. There is no doubt that an intelligent use of these reports will be of inestimable value to the farmer. The territory covered embraces the entire section from the eastern boundary of the state southwestard to Laredo and Uvalde; westward to Big Springs, and northwestward to Quanah. There will be nearly two hundred points of distribution, with many more times more of rural lines running into remote districts." D.

Massachusetts Men Study Traction in New York.

At a recent dinner given by the New York Board of Real Estate Brokers to a delegation of prominent Massachusetts men, the subject of transit facilities was discussed. The problems with which Boston has to contend were quite fully described by John J. Martin, of the Massachusetts Real Estate Exchange. Other interesting talks were given by both New York and Massachusetts men.

The day following the banquet was devoted to a thorough inspection of the transit and terminal facilities of New York.

EDUCATION FOR LEADERSHIP IN ELECTRICAL ENGINEERING.

PAPER AND DISCUSSION AT THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 245th meeting of the American Institute of Electrical Engineers was held at the Engineering Societies' Building, New York, N. Y., on Friday evening, April 15. President Stillwell called the meeting to order at 8:25 p. m.

Secretary Pope announced that at the afternoon meeting of the Board of Directors there were elected 131 new associates. The following associates were transferred to the grade of member: Clifford Sherron MacCalla, Spokane, Wash.; John F. Vaughan, Boston, Mass.; Wilbur Hayes Thompson, Wheeling, W. Va.; Frank Baldwin Jewett, New York, N. Y. Mr. Pope further stated that it had been decided to hold the annual convention this year at the Waumbeck Hotel, Jefferson, N. H., on June 27, 28, 29 and 30.

The president, in introducing the speaker for the evening, Dr. Samuel Sheldon, past president of the Institute and professor of physics and electrical engineering at the Brooklyn (N. Y.) Polytechnic Institute, remarked that the subject under discussion was one of peculiar interest to the Institute. He emphasized the fact that the one thing which is of peculiar and especial value to members is the opportunity afforded by the proceedings and transactions to record for the benefit of the entire membership the knowledge that comes to the workers in many fields, theoretical or practical. "We are always glad," he said, "to have the subject of the education of the young engineers discussed, realizing, as we must, that the future attainments of our profession depends primarily upon the good start that the young men who are to take our places obtain in our educational establishments. . . . We are fortunate in having with us a number of distinguished gentlemen, not members of the Institute, who have complimented us and honored us by coming here to discuss this paper from the standpoint of experts who are giving their principal attention to this vastly important subject."

Dr. Samuel Sheldon then presented in abstract his paper entitled "Education for Leadership in Electrical Engineering."

EDUCATION FOR LEADERSHIP IN ELECTRICAL ENGINEERING.

In this paper Doctor Sheldon first makes a statistical analysis to show that the percentage of electrical engineers in this country is very much less than the percentage of the total wealth of the country invested in electrical industries. He also shows that electrical engineering leaders are about as numerous in proportion to the total number of electrical engineers as in other engineering professions, but that engineers who are leaders are in general not as numerous as the importance of engineering enterprises would seem to warrant. Analyzing the educational preparation of ninety-eight notable members of the American Institute of Electrical Engineers he finds 80.6 per cent having college degrees and ninety per cent who had college instruction. A further analysis of the acquired traits of twelve of these notable electrical engineers as made by five disinterested and competent judges is then given. The five fundamental acquired traits considered are: mental training, distributed and comprehensive knowledge, facility of expression, discipline of the will and aesthetic taste. The last analysis showed mental training to be very highly developed among these twelve picked leaders. Doctor Sheldon concludes that if any changes are advisable in educational methods in order to produce still higher character in engineering leaders, they should be directed to those educational processes that result in marked development of the last four of the acquired traits named above. Greater attention should be directed to the study of languages, literature, fine arts, history and the political and social sciences, with the idea of gaining a mastery of the methods of thought and of action of man and of men. In other words a knowledge of human nature is essential to leadership, for the very word implies a man to lead and men to follow. Doctor Sheldon therefore recommends that any college seeking to produce leaders in engineering should adopt (1) a more discriminative system of selecting entering students, (2) new subjects and methods of teaching them, particularly literature, and (3) that more time should be found for these subjects.

The president called on Dr. Charles S. Howe, president of the Case School of Applied Science, Cleveland, Ohio, to open the discussion.

Doctor Howe said that although not an electrical engineer, he was very much interested in the training of electrical engineers, hence he was able to understand the paper. He thought that the reason why many eminent men did not possess the degree of E. E. was that many of the foremost colleges did not grant this degree. One part of engineering education in colleges was imparting to the student a certain amount of knowledge of actual facts. But far more important than the giving of facts by teaching a few definite things is the ability in the student to know where to find the things he wants at any time of his career; that is, the ability to search. We ought to teach our students to use dictionaries, and encyclopedias, and books of reference, libraries in general, the catalogues of the great manufacturing establishments, the magazines, the special reports of societies, etc., until, when a student is confronted with any problem, he will practically know just where to go to find the proper information upon that subject. And then the other thing which we should try to teach him is to think, to reason for himself. He believes that it would be possible to lay out a systematic course of instruction in teaching students to think for themselves. Most men are not leaders, they are men who follow, they follow the men before them, and this process of thinking is, as a rule, at the present time learned by men themselves, without very much instruction on the subject. If we can only develop methods by which students will understand the laws of learning to think, to think along engineering lines, we shall greatly increase the number of leaders, and he believed the leaders themselves will be still greater leaders. Many of our institutions are coming to believe that the technical course should be increased to five years, so that more time may be given to courses of broader instruction, not now given, and that will also be additional time to give to engineering subjects. The reason why all this has not been done in the past has been that the technical schools have utterly been unable to graduate men enough to fill the places open for them. The subject of English composition and rhetoric especially has been greatly neglected in most of our technical schools, until within a very few years. Now we are beginning to devote more time to this subject, because we are finding out that the technical graduates we have been sending out without any ability to write, without any facility of expression, do not succeed as well as the men who can express their thoughts well upon paper and present engineering subjects to boards of directors or to organizations like the Institute. Another thing which is necessary for leadership is the ability to get along with and to handle men. That is something that it is exceedingly difficult for us to teach in the technical school. As a rule, we do not do it, but it is true that the man who works by himself, as a rule, does not rise very much; he may, under exceptional situations, but as a rule he does not. It is the man who can work with other men, and handle them, who generally achieves the greatest success.

The president then called upon Dr. Abraham Flexner, who is associated with Doctor Pritchett in the administration of the Carnegie Foundation for the Advancement of Teaching.

Doctor Flexner said that it seemed to him that in this country we have been rather apt to concentrate our educational processes on instrumental proficiency, on the making of men who could do particular things efficiently and well—good surgeons, good doctors, good lawyers, in the narrow and professional sense in which those terms are used. He thought that perhaps some of the results which Mr. Sheldon has unearthed might be traced back to rather narrow conceptions which have dominated our efforts at professional education. On the other hand, when you advocate broader or more cultural training, you are at once involved in a mist. It seems extremely difficult to make out just what is culture, and what is vocation or profession, or instrumental training—in his own efforts to think coherently and accurately in dealing with problems of that sort, he had been a good deal perplexed and mystified as to where one sort of education begins and one sort ends, and what is, after all, the relation between cultural and professional or vocational training. Are they actually different, or are they different aspects of the same thing? What is their relation? Taking this for his theme, Doctor Flexner read a short paper he had prepared on the subject along the lines indicated above.

J. W. Lieb, Jr., past president of the American Institute of Electrical Engineers, was next asked to continue this discussion, as one who had had much practical and executive engineering experience and who had employed many technical graduates.

Mr. Lieb, referring to the question of specialization, said that this hardly needs emphasis, as the American Institute of Electrical Engineers is beginning already to sub-specialize within the domain of electrical engineering, inasmuch as this subject of itself it becoming already too broad for one man to become expert in all of its ramifications. This has also taken place in the past history of the broader field of engineering—beginning with civil engineering, as a general foundation, it was found very soon necessary to specialize in mechanical, and mining and electrical engineering, and now the technical schools in mechanical engineering find it most difficult to cover fairly the field with the tremendous expansion which electrical engineering has brought about, and are now face to face with the proposition of subdividing their courses into the several constituent fields. Turning to facility of expression, both oral and written, Mr. Lieb said that this is a subject which appealed to him very strongly, because as a matter of experience he had found that it is one direction in which the product of our technical schools is most apt to be deficient. The power of expressing and of presenting one's conclusions is a most important element, a most important faculty, which the successful engineer should possess, if he wishes to present his findings and have them adopted. With regard to modifications in the present methods of technical instruction,—as one grows older, he said, one feels the lack of the broader culture to which repeated reference has been made, which it has not been possible for the technical schools to give. This is a serious proposition, as we are already face to face with the evident necessity of expanding the course from four to five years. This expansion is of pressing importance, from the standpoint, one might say, of vocational requirements, and where, usually, the time for a wider acquaintance with the humanities is not afforded. This is a serious question which the engineer is facing. It is almost impossible for the engineer to make up for lost time after graduation. The necessity of following the tremendously rapid developments in all of the fields of engineering makes self-culture a matter of extreme difficulty; and therefore, the most that the purely technical school can hope to accomplish is to instill in the minds of the students a love for purely cultural studies, for literature and art, in all their various manifestations, in the expectation that with more mature opportunities that come in after professional life, natural expansion may have its way.

Prof. Dugald C. Jackson said that often the engineering colleges through their fixed curricula seem to usurp the place of the arts courses in the actual training of the men, due to the fact that the arts courses have fallen into a haphazard fashion of general selection. The engineering courses have become too flexible, and the arts courses too haphazard. Each is taking the backward path and apparently approaching each other, and we may see the time when the two are practically fused as far as their processes at least are concerned. He had not a great deal of sympathy with the proposition of making a five-year or six-year college course, or calling for an arts degree as a part of the entrance requirement to the engineering school. One factor that affects our enginering aspect is the self-centeredness of the engineers themselves. He was beoming very strongly impressed by the fact that the engineers are a selfish race, not intentionally, but by mere failure to give thought to the question. They are by nature altruistic, but in fact they are not giving the amount of attention to public affairs which in any way compares with that given by other professional men, lawyers, physicians, or by men of the type of bankers, the great merchants.

Professor Jackson called attention to the fact that Doctor Sheldon's statistics are original. The book "Who's Who in America" is supposed to have in it the name of nearly every man who has reached the highest rank of prominence in the United States. That book contains the names of about one and one-third per cent of all the men in professional service, as shown by the statistics of the United States Census. Of the members of the American Institute of Electrical Engineers nearly twenty per cent are found in that book. Either the Institute has been selecting its full members from among its associate membership with most extraordinary care to go into the upper range, he said, or else the training that has been given in the engineering schools has been a very effective one, because all of these men are engineering school trained men. Again, the percentage of the associates of the Institute in "Who's Who in America," is something like one per cent, but it approaches the general average of the professional men in the United States. Furthermore, of the ninety-eight members of the Institute whose names are in "Who's Who in America," thirty-five have the doctor's degree. Professor Jackson proceeded to analyze and discuss some of Doctor Sheldon's figures. In conclusion, he remarked that the author of the paper in speaking of facility of expression refers to it as spoken, written or wrought,—whether

by chance or intention, these three words represent eloquence, literature and art, in connection with facility of expression, and it is to be remembered that these three accomplishments are the accomplishments whereby man influences man, and it is not particularly astonishing that when facility of expression is interpreted in so wide a manner that we should average only 1.46 for the average of our apostles. He doubted very much whether most of the professions would average better, and he was somewhat surprised that the average was as high as 1.46 for the twelve chosen leaders.

Dr. A. E. Kennelly said that in regard to the vexed question as to what subjects are cultural and what subjects are vocational, he would take the position that all subjects are either vocational or cultural, according to the way in which they are taken and used, and that there is no other criterion. It is only when considered with reference to some particular line of vocation or some particular duty that certain studies are of pre-eminent importance, but every study is of absolute necessity in order to economize time, because years are limited and we cannot forever stay in school. In regard to the requirements or qualifications for leadership, he agreed with Doctor Sheldon in the general propositions that he offers, but he thought there is one item that deserves a little emphasis, and that is, that the qualifications which are competent to bring men to leadership are also qualifications that lead men to follow, that men, before leading, must be able to follow, and that the requirements of the man who shall follow are discipline and faithfulness and earnestness in whatever he undertakes. The necessity of coming in contact and knowing how to deal with other men, how other men are to be interested or influenced, or guided, is suggested as important as the knowledge that comes by books or training in college or in school. It seems to be necessary for us to study our fellow creatures, in order to get the best results out of them, and ourselves, and he believed that is as important as the study of the things we learn in books and schools; and that the study of ideals is of the greatest importance, so that anything we do, whether we sweep the floor or put up a building, any act we may perform may be done with the best of our ability, the best that is in us, and by that alone is our work to be judged and are we to be judged.

William McClellan opined that there is sufficient evidence now of a change in our educational courses, in our most prominent institutions, to show that what they are trying to introduce into the profession is unity. He asserted that all technical degrees should be abolished as a first course. Thus every man coming from an engineering school could get the degree of B. S., so that we should have in the profession unity; in other words, he would like to see colleges first of all train engineers, because after having been in the position of having young engineers work for him, after they come out of college, he found the thing they lack in almost every case is general knowledge. Personally, he would prefer greatly to have a man with a thorough knowledge of physics, chemistry and thermodynamics, than he would have him with a thorough knowledge of what might be called the engineering side of these same subjects. His point was, to *teach* engineering and *train* men as engineers, so as to fit the mind, and he did not think it will take five years, but that it could be done in four years.

The president, before calling on Doctor Sheldon to close the discussion, called attention to two things that had been emphasized particularly. In the first place, he did not agree with Mr. Lieb entirely with regard to what he said about the difficulties of self-culture after graduation. He believed that the man who stops his education upon graduation, and exclusively specializes, makes a great mistake. There are any amount of opportunities for a man to continue his education in a manner that is broadening and effective. The other suggestion is this—that education in almost any line that teaches logic and a sense of proportion is engineering education. In constructive engineering the most valuable faculty, in his judgment, is that which may be designated as the sense of proportion, what the painters would call perspective.

Doctor Sheldon, in closing, said that there was but a single point which occurred to him as a result of the discussion, and that was in reference to the discussion of Doctor Howe, with regard to his (Doctor Sheldon's) recommendation that a new system of selection of entering students should be adopted. He thought it is a well recognized fact that nearly one-third of entering freshmen should never come to the technical school. What they lack is not that which the school or any one else can give them, it is natural ability, not capacity for acquiring ability. Examinations conducted along the standard methods and standard lines cannot determine anything except acquired abilities. There should be an examination which shall determine whether or not the proper natural traits are present in the candidate or not.

President Stillwell thereupon thanked the author of the paper, and Doctors Howe and Flexner who were present as invited guests, for their discussions. The meeting then adjourned.

A Power Plant on Piles.

The new plant of the Atlantic City Electric Company, which is being built in the meadow near New York Avenue, offers considerable difficulty to the selection of a stable and permanent style of foundation.

Owing to the extremely marshy character of the soil it was necessary to plan a piling system, and from the results of tests it is calculated that fifteen hundred and thirty piles will be necessary to support the station. The top of these piles will be six inches below the level of low tide so that they will be constantly submerged. Upon these piles will be placed a solid mat or pad of concrete, upon which will rest the building and machinery foundations, some of which will be carried to ten feet above low tide.

St. Louis & Kansas City Electric Plans.

Officials of the St. Louis & Kansas City Electric Company, whose capital is $15,000,000, announce that the engineering corps has finished the locating of seventy-five per cent of the road. The company plans to construct a double tracked air line between St. Louis and Kansas City at the shortest distance possible estimated at 250 miles. It is intended to install hourly local service, and through fast express trains.

Nebraska Electrical Association.

The annual convention of the Nebraska Electrical Association will be held at Lincoln, Neb., on May 3, 4 and 5. Several interesting papers have been prepared and the meeting will be profitable to all those in attendance.

Commission News from New York.

The New York State Public Service Commission, Second District, has authorized the People's Gas and Electric Company of Oswego to acquire all the capital stock, estate, property, rights, privileges and franchises of the Citizens' Lighting Company of Oswego and to operate the same. The Citizens' Light Company is authorized to transfer its franchises, etc., to the People's company.

The People's Gas and Electric Company is authorized to issue $150,000 additional common capital stock at par, the proceeds to be used for the following purposes and no other: $76,000 par value of common capital stock to acquire the total capital stock of the Citizens' Lighting Company together with all the franchises, works and system of this company and $74,000 of stock to be sold at par and the proceeds to be used for paying outstanding obligations which have been incurred in construction, extension and improvement of the property of the company.

The commission has also authorized the Western New York and Pennsylvania Traction Company to increase its capital stock to the sum of $2,600,000 to consist of common capital stock, $1,000,000; first preferred cumulative six per cent stock, $600,000, and second preferred non-cumulative five per cent stock, $1,000,000 and to issue the same for the following purposes: The common stock to the amount of $1,000,000 to be issued in exchange share for share for the existing common stock of the company; the second preferred non-cumulative stock to the amount of $1,000,000 to be issued in exchange, share for share, for the existing five per cent cumulative stock of the company; the six per cent cumulative stock to the amount of not exceeding $500,000 to be issued in exchange for a like principal amount of first and refunding mortgage dated December 1, 1906; the first preferred stock of but not exceeding the sum of $100,000 in payment of a like amount of obligations of the company now outstanding, proceeds of the obligations having been used for building the Carrollton-Bradford extension, $16,790; building Salamanca-Little Valley extension, $75,000; construction Little Valley substation building, $2,640; construction portable substation, $1,526; drilling new gas wells, $6,500.

A further hearing has been given on the matter of the application of the South Shore Gas Company for authority to begin construction and exercise franchises in the incorporated villages of Babylon, Amityville and Farmingdale and the town of Babylon, Suffolk county. The company asks to issue capital stock to the amount of $50,000, of which $25,000 is for immediate use, and to execute a mortgage for $150,000 and issue bonds thereunder to the amount of $100,000. The commission took the matter under advisement.

A petition of the East Hampton Electric Light Company of East Hampton, Suffolk County, was also heard recently by the commission. The company asks for authority to execute and deliver a first mortgage on its property for $50,000 and to issue at the present time $34,500 in bonds to be secured by said mortgage and a further issuance of $15,500 also secured by said mortgage. The present issue of bonds is to be used to refund note indebtedness of the company incurred by it in the transaction of its business. The commission took this petition under advisement also.

Chicago Electric Club.

The regular meeting and luncheon of the Chicago Electric Club, held on Wednesday, April 13, was enlivened by the presentation of a most interesting address by W. H. Merrill, manager of the Underwriters Laboratories, Inc., of Chicago, Ill. Mr. Merrill's subject was the "Relation of Electricity to the National Fire Waste." In opening his address Mr. Merrill called attention to the great economic loss which was occasioned annually in this country through the fire waste. Unlike other catastrophies he said the fire waste was an absolute loss to those who were unfortunate enough to be subjected to its ravages. When property amounting to $250,000,000 a year was converted into ashes it meant a total waste, something from which nothing more would spring, and represented the maximum of the possible economic destruction that could take place through ulterior agencies. In this respect he said that the hazard of electricity played a considerable part, but that the hazard was not so great as many would estimate. Between five and twenty per cent, he thought, was the part that electrical hazard played in the aggregate fire loss visited upon the country. The total fire loss, however, was great in this country compared to that in other countries, and this was principally because of the attitude of mind of the police and legal departments concerning the contributory negligence on the part of those suffering the loss by fire. The method of imposing the burden of the unfortunate upon the fortunate was responsible for the lack of attention given to preventive methods, and this lack in fact was what constituted the greatest of the possibilities for the building up of a huge loss in American cities. He said that the development of electrical fire preventing and danger-announcing devices had not kept pace with other phases of electrical invention, and he deplored the fact that American inventors had not exercised more ingenuity toward the perfecting of fire-alarm systems. He indicated the control that the electrical engineer possssed in making his part of the installation as nearly fire-proof as possible, and showed how the greatest care was necessary so that there would not be an element of danger existing in many forms of wiring and in other uses of electrical apparatus.

Following the remarks by Mr. Merrill, D. L. Gaskill, of Greenville, Ohio, secretary of the Ohio Electric Light Association spoke briefly on the subject of the fire risk and indicated where very unjustly the electric lighting company had been made the scapegoat for fires which were obviously not caused by defective wiring. He extended a cordial welcome to the members of the Chicago Electric Club to attend the coming convention of the Ohio Electric Light Association which will be held in July at the Breakers, Cedar Point.

After a rising vote of thanks to Mr. Merrill and to Mr. Gaskill, the meeting adjourned.

Chicago City Railway.

The Chicago City Railway has in operation 840 double-truck cars, the average cost of which was $6,500, and forty-five more will be delivered within six weeks. Under the terms of the ordinance only 800 were required at the end of the rehabilitation period April 15.

Its new track with grooved rails weighing 129 pounds to the yard cost approximately $40,000 a mile, including paving. Wire and poles cost $4,800 a mile.

Waterpower Rates in Wisconsin.

In the case of the citizens of Hudson, Wis., against the Burkhardt Milling and Electric Power Company, the Wisconsin Railroad Commission makes an interesting statement about the proper methods by which the value of waterpower may be ascertained. The commission holds that the common method used by engineers of valuing waterpower at so much horsepower, about the same as the cost for steampower, is not a fair method. Such a method, the commission says, would deprive a community of the advantage it should have in the fact that a waterpower is conveniently located, by which statement the commission upholds the opinion that waterpowers are not purely private properties, but their advantages should be shared by the whole community.

The case, which has been under consideration for over a year, was brought up by the citizens of Hudson, Wis., who claimed that the rates charged for lighting were too much, as the power was obtained from the St. Croix River. After careful consideration, the commission concluded that the rates were not only reasonable, but that the company would be justified in slightly raising the rate. The present rates are ten cents per kilowatt-hour for residence lighting and eight cents per kilowatt-hour for commercial lighting. The commission authorizes a minimum monthly bill of seventy-five cents, a charge of eleven cents per kilowatt-hour for the first thirty hours' use of the active load per month, nine cents for the next sixty hours' use of the active load, and six cents per kilowatt-hour for all excesses over sixty hours' use of the active load, which is placed at fifty-five per cent of the connected load. M.

Electrical Exports for February.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has issued its summary of imports and exports of the United States for the month of February. From this the following data relative to the electrical exports from this country during February are taken.

Electrical appliances exported during February while less than the amount exported in January, greatly exceeds the exports of February last year and the total for eight months ended February is somewhat over $1,500,000 greater than the eight months ended February, 1909.

The exports of electrical machinery have been less than in January and also for the eight months ended February, 1910, as compared with 1909.

The following figures show the exact values of exports for both electrical apparatus and machinery for eight months ended February, 1910, and 1909: 1909, $8,002,428; 1910, $8,616,637.

The comparative monthly data are as follows:

	January,	February	
	1910.	1910.	1909.
Electric Appliances	$621,469	$607,359	$462,856
Machinery	565,838	331,136	598,736
Total	$1,187,307	$938,495	$1,061,592

The principal countries to which electric products were shipped from the United States, during February, together with the values of these exports are as follows:

	—Electrical—	
Exported to—	Appliances.	Machinery.
United Kingdom	$ 49,831	$21,413
France	915	18,553
Germany	5,405	9,310
Other Europe	7,133	20,251
British North America	137,572	82,109
Central American States and British Honduras	31,095	7,185
Mexico	64,820	48,182
Cuba	53,487	19,421
Other West Indias and Bermuda	6,703	5,731
Argentina	36,871	4,317
Brazil	123,719	17,580
Other South America	31,469	664
Japan	31,927	12,525
British Australasia	3,860	12,272
Philippine Islands	3,752	1,698
British Africa	2,912	25,018

Receiver's Reports Approved.

Judge Lacombe of the United States Circuit Court has handed down an order approving reports of receivers Joline and Robinson of the Metropolitan Street Railway Company, and W. W. Ladd of the New York City Railway Company, and the disposition of the proceeds of receivers' certificates issued from January 1, 1909, to June 30, 1909, and also the separate accounts covering the same period.

The court also approved of the disposition of special funds obtained from fire insurance companies for the destruction of the properties at Second Avenue and Ninety-sixth street burned in February, 1908, at Avenue B and Fourteenth street destroyed by fire in October, 1907, and at Madison avenue and Eighty-sixth street, which was destroyed in June, 1907. He also approved of the disposition of a special construction fund of the Central Trust and Realty Company, all of which accountings have been made to Special Master W. L. Thomas. Judge Lacombe has issued an order directing Joline and Robinson, receivers of the Metropolitan Street Railway Company, to expend $510,000 on the tracks of the Eighth Avenue street railroad to put it in perfect working order.

Philadelphia Rapid Transit to Float $2,500,000 Loan.

The Philadelphia Rapid Transit Company, which recently announced that it had won from its striking employes, has asked permission of the city to float a new loan of $2,500,000.

In a communication submitting the ordinance President Kruger stated that "the extraordinary expenses recently incurred have reduced the reserve capital which the company was counting on to make improvements and additions to its lines, power and equipment, and leaves the company today with insufficient money for such purposes." The communication was referred to the Finance Committee of Councils.

The consent of Councils is made necessary because of an agreement entered into between the City of Philadelphia and the Rapid Transit Company by which the city became a partner and received representation on the transit board.

Third Avenue to Pay Taxes.

The Third Avenue Railroad Company has decided to pay New York city in full all franchise taxes that are in arrears. Total arrears, according to Corporation Counsel, are $1,655,000. Receiver Whitridge paid $1,000,000 to the city last December, issuing receiver's certificates for that amount.

At the time the part payment was made, Receiver Whitridge protested to the sum of $1,250,000 fixed by Comptroller Metz, maintaining that it was excessive. He has agreed, however, to pay the amount now asked.

Sterilization by Short-Length Ether Waves.

At a meeting of the Academy of Sciences at Paris, France, on February 21 last, M. Billon-Daguerre described an apparatus for the sterilization of water, in which are used radiations of very short wave-length. These waves occur in the invisible part of the spectrum and have about twenty-five times the chemical action of those emitted by the mercury-vapor lamp. The possibility was pointed out of utilizing commercially such an apparatus.

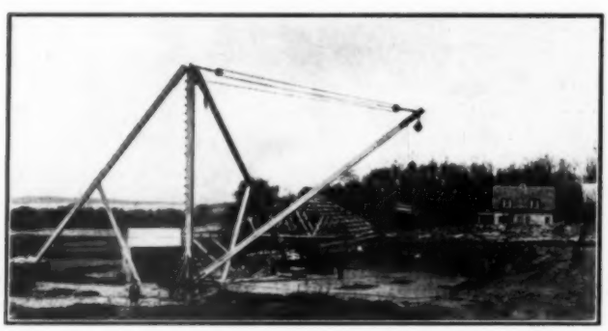
CENTRAL-STATION PRACTICE

Transmission—Interior Wiring.

WATER POWER DEVELOPMENT AT KEOKUK AND HAMILTON.

BY C. L. VESTAL.

The Keokuk and Hamilton Water Power Company, which began work on a dam at the foot of the Des Moines Rapids in the Mississippi River on January 10, last, is still pushing that work with vigor. A force of 150 men has been employed most of the time in preliminary excavation in the bottom lands on the east side of the river below the road, and especially in removing the soil from the quarry rock in the hill.



ON THE KEOKUK AND HAMILTON WATER POWER DAM. THE HOUSE TO THE RIGHT HAS BEEN TURNED INTO AN OFFICE. VIEW TAKEN APRIL 1, 1910.

ON THE KEOKUK AND HAMILTON DAM. WORK AT THE EASTERN TERMINUS ABOUT MIDDLE OF MARCH, 1910. CEMENT HOUSE BEING BUILT BEHIND DERRICK.

The engineers expect that all the rock in the whole immense project can be taken from this hill. It is Keokuk limestone of a good quality, and underlies the whole property of several acres which the power company purchased for its rock, and to furnish sites for offices, warehouses, repair and machine shops, cement house, mixing machinery, crushers, tracks and derricks.

At the present time something more than 100 men are at work, mainly in opening up the quarries. Two derricks are now in operation, one in the quarry proper on the hillside, the other in the excavation for the eastern end of the spillway and abutments. These derricks are of the stiff-leg type. The masts are forty feet high and made of Oregon fir, while the booms are fifty-five feet long. Each is operated by a vertical steam engine of twenty horsepower. The engine connects with the cable drums by means of clutches. These, with the reversing gear, are conveniently under the hand of the operator.

To take away the excavated debris there has been built a dump-car track following the gully for a few rods east into the quarry. When a car is filled it is allowed to roll down to the end of the dump by gravity, under control of the brake. When the car is dumped it is hauled back up the incline by means of a rope attached to the car and pulled by a hoisting engine. This arrangement is, however, only temporary, as a small hauling locomotive for the dump cars is now (April 16) on the way and is expected to be in operation by April 20.

The company has officially stated that masonry to the extent of 550,000 cubic yards is to be constructed. This will require about 500,000 barrels of cement. The work will also use about 7,000 tons of steel. The reason for the quantities of concrete work represented by these figures may be seen when it is considered that the main spillway alone, exclusive of abutments, is to extend at right angles across the channel for a distance of 4,400 feet, while it is to be thirty-seven feet from base to crest, and forty-three feet wide at the former. A cross section of it would show a perpendicular line nearly to the crest on the upstream side, and an ogee curve on the downstream. It will be of solid concrete, without reinforcement of any kind. On top of it will be a superstructure containing 116 steel floodgates, each thirty feet wide and eleven feet high. The superstructure itself will extend upward above the spillway for twenty-one feet, and will be carried on concrete piers eight feet thick and twenty-nine feet wide and built integral with the spillway. These piers will also support an arched bridge, which will carry tracks on which will run the electric hoists to operate the gates. The water will at all times be maintained by these gates at the desired level. It will not at any time flow over the superstructure. The head as thus regulated will vary from twenty-one to thirty-five feet.

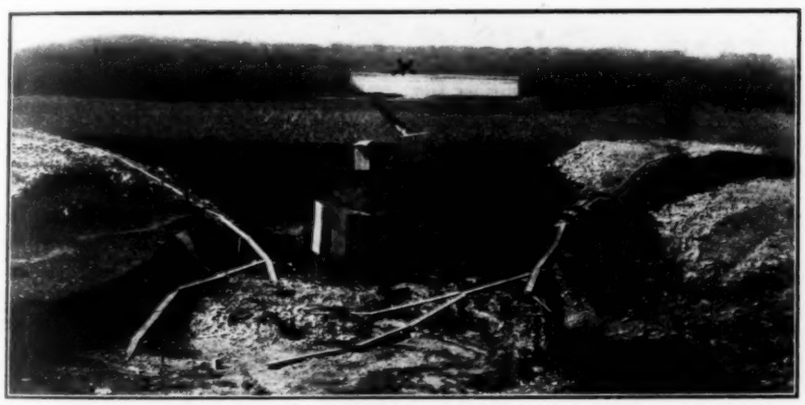
It should be understood that part of the great amount of masonry required will be used in the construction of a new lock, drydock and ice fender, as well as in the foundation for the power house. The power-house superstructure will extend downstream from the Iowa end of the spillway for a distance of 1,400 feet, and will be 123 feet wide and 133 feet high. The substructure will be of solid concrete, and in it will be molded the turbine pits and water passages. The first floor will be the

power room proper. It will contain the thirty generating units, the rotating parts of which will be mounted upon the perpendicular turbine shafts. The great weight of these parts will be mounted on thrust bearings located in chambers just below the generators. Each generator with its prime mover will constitute an independent unit, with its own speed governor and auxiliary apparatus. The third story of the power house will contain the switching apparatus and transformers.

In order to prevent floating logs and ice from entering the turbine pits an ice guard will extend upstream from the western end of the spillway for a distance of 2,800 feet, in a slight curve toward the Iowa shore, with which it will form a junction by means of a gate. This ice guard will be built of concrete, with arched openings below the surface of the water.

When the dam is built the Des Moines Rapids as such will cease to exist, and the government canal, which the Rapids have made absolutely necessary to successful river navigation, will be drowned out. In its place, however, will be built a single lock, with an ample drydock, to take the place of those flooded. Thus, a boat which now must pass through three locks and more than seven miles of canal, will, upon completion of the dam, have to pass only one lock. Only about one-third to one-half of the time now required will then be needed. It is thus seen that the power dam will be a distinct aid to navigation.

There will be developed for sale 200,000 horsepower. The first long-distance transmission line will be run to St. Louis.



EAST END OF KEOKUK AND HAMILTON WATER POWER DAM. VIEW TAKEN MARCH 1, 1910. THE CROSS SHOWS WHERE THE UPPER END OF THE POWER HOUSE WILL BE. THE SMALL BUILDINGS ARE SHELTERS FOR THE PUMPS.

Central-Station Stimulation.

The Central Station Development Company, of Cleveland, Ohio, has published a rare book entitled, "Modern Progressive New Business Methods." The object of this book is to point out how to find, get and keep new business. There is a comprehensive arrangement of several successful schemes designed to acquire new business without disturbing the present connected load, and also a complete working system showing card-index, files, form letters, folders, contracts, etc. In this edition of the handbook there is dealt with especially the items of interest and value to managers which may be most readily exploited, and through which new business methods and a system may be established that will embody the principles recognized in commercial affairs as vitally essential to their success. In a later edition there will be dealt with the weightier problems of unwired houses, how to improve the load through the increased use of motors, establishing automobile charging stations, installing mercury-arc rectifiers, municipal street and boulevard lighting, and other equally important sources of revenue.

Among the many points of great interest and value dealt with in this book the following stand out prominently: "Advertising Matter Successfully Used by Central Station Companies"; Co-operative Agreements with Central Stations and Dealers"; "The Illuminating Engineering Department"; "Featuring Apparatus"; "Sixty-Day Trials"; "Residence Campaigns"; "Residence Forms"; "Cost of Lighting"; "City Lighting Campaign"; "Girls for Residential Campaign Work"; "Lasting Impressions"; "Incomplete Central-Station Records"; "New Business Department Systems"; "Outside Lighting Possibilities"; "Repairing Defective Wiring Form Letter"; "Sewing-Machine Motor Campaign"; "Partial Payment Plans"; "Vacuum Cleaner Campaign"; "What 3.1-Watt Carbon Lamps Mean."

The handbook also contains a complete transcript of the paper by S. E. Doane, chief engineer of the National Electric Lamp Association, entitled "Cost of Light," and the terms of the offer of the Central Station Development Company of $1,500 in prizes for the twenty-one best solutions of the rate problem based upon Mr. Doane's paper.

It will be remembered that Mr. Doane points out that profits should be made upon the fixed charges as well as upon the kilowatt-hour charge, and that the latter should be so low that the loss of revenue due to the replacement of carbon lamps by lamps of higher efficiency would not diminish the return to the station beyond the decrease in cost to the station. He points out that the station could handle its present customers with a portion of its present equipment, and that it would be able to take on more customers before the station again became loaded, also that a change on the part of the majority of the station's customers to lamps of an efficiency higher than that of carbon would not cause the station to lose money. This change would be a growth of some little time. The total change would be a repetition of the following evolution: A few cutomers changing to the higher efficiency lamps would release part of the generating capacity of the station, thus enabling the station to add a few more customers. These new customers would come on to the central station circuits at a large profit to the station, inasmuch as the old customers were paying one component of the fixed charges, so that when enough new customers had been taken on the station would decrease the fixed charges to all. The reduced rates would further stimulate the use of electric lighting and would make the taking on of new customers more easy. With continued increase of patronage there could be another reduction in rates, and so on until the station was again fully loaded, the rate constantly becoming lower.

PRICE OF ELECTRICITY.[1]

BY R. S. HALE.[2]

The question of prices depends very largely, in fact, entirely on costs. These differ in different companies and from time to time, but I shall devote my attention almost exclusively to the costs and prices of the Boston Edison Company in recent years because so far as the principles are concerned, these differ but slightly from those of other companies. However, as our costs vary from year to year, and as we are discussing the principles rather than the exact figures, I wish it understood that I am not attempting to give them with absolute accuracy, but am using them chiefly for illustration. In fact, the 1904 figures are higher than our present costs, though the principles are the same.

The total cost for supplying service is, of course, the same as the gross income. When I say that the total cost corresponds to the gross income, I am assuming that a fair dividend on the stock is really a part of the cost. Of course, if there is a deficit after paying a fair dividend, or if there is a larger surplus than is necessary for a proper reserve, then the gross income is less or more than the total cost, but in most well run companies, the gross income and the total costs are substantially the same.

The question of the total cost is simple. It is merely a question of adding together the costs of the different departments and of the various taxes, fixed charges, reasonable dividends, etc.

The question of the total of the prices is, likewise, simple, because the total of the prices must be the total of the costs.

The really difficult question is the proportioning the part of the total costs to be borne by each different customer, or class of customers.

Using Boston Edison figures, the total cost of our current and service was $2,700,000 in 1904, and $4,100,000 in 1909, and these total amounts were a fair price for our total current and service; but not only is it necessary that the total price should be a fair one, it is also necessary that the division of the price among our different customers should be a fair one. In fact, this is a most necessary feature since it does not affect a business man very seriously to pay an extra charge of ten per cent provided his competitor likewise pays the same extra charge, while if a business man pays only a fair charge, but his competitor gets ten per cent rebate, then the first customer is worse off in spite of the fact that in this case the seller is getting a low price, while in the other case the seller was getting an unfairly high price.

Now, how is the $2,700,000 which it cost the Boston Edison Company in 1904, or the $4,100,000 which it cost it in 1909, to be divided up among its customers.

If we divide the total income by the total number of customers we find that the average income was about $200 per customer in 1904, or $160 in 1909.

If we divide the gross income by the total number of lamps or their equivalent, we find the cost was about $3 per lamp in 1904, or $2.25 in 1909.

If we divide the gross income by the total number of kilowatt hours, we find that the average cost was about ten cents per kilowatt hour in 1904, or about six and a half cents per kilowatt hour in 1909.

While these are the average costs or average prices per customer, per lamp, or per kilowatt-hour, it is perfectly clear that we cannot depend solely on averages in any particular case any more than we, ourselves, would be satisfied to have the total payrolls of our various companies divided by the total number of employes so that each employe should be paid exactly the same salary. The average cost per customer of the Boston Edison Company is between $150 and $200 each, but some customers cost very much more and some very much less. The average cost per lamp is between $2 and $3, but some lamps cost much more and some much less. The average cost per kilowatt-hour is from six cents to ten cents, but some kilowatt-hours cost us fifteen cents, twenty cents, thirty cents and fifty cents each, and some cost hardly more than one-half cent each. It is obvious that we cannot make the same charge either per customer, or per lamp, or per kilowatt-hour.

When work is done by private companies the prices should depend on the costs, since there is no special reason for giving electricity without charge or at less than cost, as the use of roads and bridges is given without charge, and there should be some electric unit or basis of charge proportional to cost. There is no essential reason why either the kilowatt-hour or its multiples or submultiples, the lamp-hour or horsepower-hour, should have been used. The telephone companies and some water companies charge so much per customer, but by a graded differential system they take account of the fact that some customers cost them more than others. In the old days the electric companies charged so much per lamp (usually $12 per annum), and some electric companies and some water companies still use the same principle, the water companies' charge being so much per fixture. In all these cases, however, the companies (or municipalities, when the supply is municipal) have by various systems of differential charges, recognized the fact that some telephones, or customers, or lamps, or fixtures cost them more than others.

I will not go into the history and science of electric supply to explain why it is that most electric companies have finally settled on the kilowatt-hour as the basis of charge; but I do wish to state most emphatically that there is just as much reason for differentiating between the kilowatt-hours that cost the company twenty cents, thirty cents and fifty cents each, and even more, and the kilowatt-hours that cost the company less than one-half cent each as there is between customers and lamps. It would be just as unfair to charge the same rate per kilowatt-hour for all kilowatt-hours as it would be to charge each customer $160 per year, whether it cost us $1 a month to supply him or $10,000 a month. We intend that each customer shall give us a fair margin of profit, if we can get it and shall in no case be supplied at a loss. We supply some lamps at a cost of $1 per annum each, and even less, and get as high as $10 or $15 per annum from others, and again intend that they shall all give us, so far as possible, a fair margin of profit, and that none shall be supplied at a loss. We supply some kilowatt-hours at twenty cents and some at three-fourths cent, and while we try to get a fair margin of profit on them all, yet we actually lose money on a great many of the kilowatt-hours we supply at the highest prices.

1 Abstract of a paper presented at the convention of the New England section of the National Electric Light Association, Boston, Mass., March 16 and 17, 1910.

2 General Superintendent Sales Department, Boston Edison Company.

Now, how do we distinguish between the kilowatt hours that cost twenty cents or thirty cents, and those that cost only one-half cent? In the case of a customer we have a definite address or location and know exactly what happens when he comes on to the system and uses current. In the case of different lamps we know very clearly that to supply one lamp for a year will probably take only sixty pounds of coal and to supply another over half a ton, so that the first lamp may be supplied at the cost of half a ton of coal cheaper than the second, if the other expenses are the same. The kilowatt-hour, however, while more exact and definite than the customer or the lamp, is more a definition than a concrete quantity.

Take the case of a particular customer who has the equivalent of 10,000 to 15,000 lamps connected, of which he would probably use about 8,000 at any one time; and suppose this customer used his lights about ten hours a day, say 1,200,000 kilowatt-hours in all. Adding the cost of the coal and lamp renewals to the cost for keeping ready and dividing by the number of kilowatt-hours, we find the rate to be about 3.2 cents per kilowatt-hour; and, of course, if the customer should use his lights twenty-four hours per day the cost per kilowatt-hour would be lower still. The above analysis has been for a customer with sufficient lamps to require one-tenth of one of our turbines. It is, however, perfectly obvious if we consider a customer who only requires one-ten-thousandth of one of the turbines, say a customer with ten or twelve lamps, that most of the cost will be in the same proportion and the same per kilowatt-hour as in the case of a large customer.

Now, how shall we take care of this tremendous difference in cost between the customer who uses our investment steadily and the customer who uses our investment only a very short time? The obvious way is to charge him by the method known as the Hopkinson System, and instead of making a charge of so much per kilowatt-hour, we make the charge in two items. One item on the bill is the fixed charge, which is made in proportion to the amount of our investment that the customer uses, independently of how long he uses it. This in our case is a charge of $60 per year for each kilowatt of investment that the customer uses. In addition to the payment of this fixed charge, which corresponds to our fixed expenses, the customer pays a rate of only five cents for each kilowatt-hour that he actually does use. The result is that the customer pays in proportion to our costs. These figures are not by any means the exact costs, since when we compare our figures of costs with the prices of $60 per kilowatt and five cents per kilowatt-hour, we find that the $60 a year is too small, especially for our small customers, while the five cents per kilowatt-hour gives us a tremendous profit as compared with our operating costs after excluding our fixed charges. Still the figures that we have actually adopted, work out in practice much better than the theoretical figures. One reason is that we cannot insist on all our customers paying according to this yearly rate, and in fact the majority pay, and prefer to pay on the very simplest possible plan, and pay so much per kilowatt-hour, and we give this option largely for policy's sake.

Of course, charging so much per kilowatt-hour means that some customers are very much more profitable to us than others, but the case is not so bad as it might be, because while the customers who use our investment only a very short time means that we have a very good chance of selling the use of that investment two or three times over. Say our investment costs on a small customer are $90 a kilowatt per year. If such a customer pays us eleven cents a kilowatt-hour, then, practically speaking, ten cents an hour is available for our fixed charges, and if the customer uses the investment 300 hours a year this gives us $30 a year towards fixed charges of $90. Then if we sell the use of that investment to three customers, we get the $90 for our fixed charges only once.

If we sell it only twice we lose. If we sell it four times it balances some of the losses that occur when we only sell it once or twice.

The result of the two optional rates, one a per kilowatt-hour rate and the other the Hopkinson rate, are pretty nearly what we want, since though we lose very heavily on some of our eleven-cent customers, yet on some others we make a good profit. When, however, an eleven-cent customer uses our investment for so long a time that he would become abnormally profitable, then he has the option of taking current on our yearly rate on the Hopkinson System and getting a much lower rate per kilowatt-hour than eleven cents.

At the same time such a customer uses our investment long enough so that the profit on the five cents charge makes up for the loss in charging him only $60 per kilowatt fixed charge and the two features, or rather, the two rates balance up pretty well.

When we get beyond a certain point the costs are not the same for different size customers. A pole line for 100,000 lamps costs almost nothing per lamp. A pole line for a thousand lamps begins to be expensive, while a pole line for ten lamps or one lamp is almost prohibitive in cost. In other words, the cost of manufacturing electricity and delivering it in wholesale quantities at a single point is one thing, while taking this electricity and distributing it retail makes a very great additional expense.

Now take one of our practical cases. When the Town of Wellesley comes to us and wants us to deliver our current wholesale at the town line, letting the town distribute it to its citizens in the town, the Edison Company is relieved of a very large amount of expensive distribution work, and naturally is willing to make a much lower price to the Town of Wellesley for its wholesale supply than it would if the Edison Company had to distribute the electricity retail in the Town of Wellesley, or than the Edison Company does make in the adjoining Town of Natick where the Edison Company has to pay the distribution expense.

This is the whole principal of wholesale and retail, the only difference between the Edison Company's business and other businesses being a question of degree.

Now, our wholesale rate is very much less than our average rate, and even than our average costs, but it should be kept clearly in mind that the small customers lose nothing in any way from the fact that the wholesale rate to large customers is less than the retail rate to the small customers. The use of our service by large customers at less than the average price does not add anything to the expense of supplying small customers, but in fact enables us to supply our small customers

at a less rate than would otherwise be necessary.

For the amount of current that would be used by a large customer who gets our wholesale discounts, the cost of making so large an amount of current for himself in an isolated plant, would be only ten or fifteen per cent greater than our price to him. At first sight, therefore, it might seem that this ten or fifteen per cent represents the advantage that the wholesale customer gets, as compared with his small competitor, over what he would get if we refused to make a wholesale rate. However, the wholesale customer gets his current, we will say fifteen per cent cheaper than if there were no central-station supply, but if the retail customer had to make his small amount of current for himself, it would cost him, not fifteen per cent, but one hundred per cent more than our price, so that the retail customer gets 100 per cent and the wholesale customer only fifteen per cent advantage from the fact that the Edison Company exists.

(To be continued.)

An Instance of Economy of Steam Power.

An interesting report was recently made by F. W. Dean, engineer, of Boston, Mass., upon a proposition of installing generator capacity in a hotel, assuming a choice to be made between steam engines, gas engines, or purchased current.

The elements of the problem were these: The heating of the hotel and warming of the hot-water supply were done by a steam plant consisting of two Babcock & Wilcox boilers, of 127 and seventy-eight horsepower, respectively. For the water heating, there was a steel tank provided with a thermostatic valve which maintained a uniform temperature. There were also the necessary feed pumps. The condensation in the steam heating system was returned and used again in the boilers.

Power was required to run three elevators, two passenger and one freight; and three small motors for operating laundry and other machinery. The necessary electric current was purchased, and was supplied on a 220-volt three-wire system, 220 volts being used for power, and 110 volts for lighting.

The problem was to provide a new supply of electricity at an annual outlay considerably less than $8,200, which was the yearly cost of the purchased current. The only scheme open was to install generators in the hotel, operating them either by steam or gas; and the specific questions were what generators were needed, whether steam or gas was the cheaper motive power under the conditions, and whether either system would be cheaper than the purchased current.

As to the generators, the requirement was that they should be able to carry the lighting load, start two of the elevators simultaneously, and operate the small motors. There were about 1,800 sixteen-candlepower lamps in the house, and the maximum lighting load, as settled by general hotel practice, was that required to operate half the lamps or 900, at one time this amounting to fifty kilowatts. Tests of the power required for the elevators and motors showed that starting the two-passenger cars took fifty horsepower, and the three small motors six horsepower. It was decided to depend on the overload capacity of the generators for the comparatively rare instances when all three elevators would be started simultaneously. Hourly readings of the meters showed that the theoretical allowance for lighting power was ample. The maximum electric power required was therefore fifty kilowatts for lighting, thirty-eight kilowatts (fifty horsepower) for starting two elevators, six kilowatts for operating three motors, a total of ninety-four kilowatts.

A 100-kilowatt generator, in duplicate, and a thirty-five-kilowatt generator for use from midnight to some early hour in the forenoon, were recommended. The cost of a gas-engine plant was estimated at a total of $27,400, this including $20,950 for three engines, and covering excavating foundation work, piping, wiring, switchboard and incidentals. The annual cost of operation of gas engines was estimated at $9,286, of which $4,504 was required for gas used for power, and $3,562 for fixed charges on the cost of the engine installation.

Three steam engines were estimated to cost $8,408, the total expense of the engines, foundation, wiring etc. being set at $13,500. The boiler plant and accessories ample in capacity for these engines, was already operating in the hotel. It was estimated that during eight months of the year the whole of the exhaust steam from steam engines could be used for heating feed water, wash water, and radiators, and that the engines would be chargeable with consuming two pounds of coal per kilowatt-hour when the exhaust was so utilized; and 7.3 pounds per kilowatt-hour in the four months when the exhaust was not so used. On the basis of an estimated annual total of 197,586 kilowatt-hours, the annual coal consumption for the engines would be 372 tons, costing at $4.34 per ton, $1614. The annual cost of steam power operation was set at a total of $4539, which included $1614 for coal, and $1,755 for fixed charges. Comparative costs were summarized as follows:

Cost of installing gas engines	$27,400
Cost of installing steam engines	13,500
Annual cost of operating gas engines	9,286
Annual cost of operating steam engines	4,539
Probable cost of purchased current	8,126

Economy of Supplying Outlying City Districts with Polyphase Current.

The increasing employment of metallic filament lamps, and consequent cheapening of the electric light, have brought about a change in the conditions of electricity supply in cities, for besides supplying the commercial districts and better-class dwellings, current has to be furnished to the districts inhabited by people of smaller means; that is, in a general way, the outlying districts. Electricity works with substations are therefore confronted by the problem of building either new stations in the distant districts, or of installing transformer stations and resorting to the employment of single or polyphase alternating current. The first course would obviously involve a great expenditure.

Taking the conditions of a city of 100,000 inhabitants as a basis for his calculations, Wilhelm Wunder finds that it is considerably more economical to supply the outlying districts with polyphase current. The costs of installation and current losses will in this case be about one-third less than with direct current. The difference in the economy is so great that in almost any city the supply of distant districts with polyphase current offers considerable economic advantage over that with direct current. The saving in capital investment is a factor of particular importance, for experience teaches that the distributing lines in outlying districts reach their full utilization much more slowly than these in the interior of a city.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), March 17.*

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

THEORETICAL NOTES ON INTERIOR LIGHTING.—II.

BY W. E. BARROWS.

Having given the values of the illumination intensity of numerous typical classes of service the question arises how to determine the number of lamps of a certain class necessary to produce the desired illumination. This may be determined very easily by means of the following expression:

$$\text{Watts per square ft.} = \frac{\text{Intensity in foot-candles or effective lumens per square foot.}}{\text{Effective lumens per watt from the illuminating source.}}$$

Or,

$$w = i/k \ldots\ldots (1)$$

provided the value of k or the lumens per watt effective in producing the desired intensity is known. The most consistent method of obtaining this value of k is by making illumination tests on actual commercial installations. Unfortunately little consistent data of this nature are available at the present time, but considerable data on experimental and comparative installations of different types have appeared from time to time in the technical press, and although those tests have in most cases been conducted under ideal conditions, they will, however, represent the conditions which should be sought in practice if the best results are to be obtained. The value of the effective lumens per watt is obviously different not only for each type of lamp, but for each style of shade, reflector, or globe used with each type of lamp. Its value also depends on the size of the room and the reflecting coefficient of the walls and ceilings.

The approximate values of k for some of the common types of lamps equipped with different reflectors are given in the following table:

TABLE 2.
DIRECT LIGHTING SYSTEM.

Lamp	Reflector	Room	Ceiling	Walls	Effective lumens per watt
Tungsten	Clear prismatic	large	light	light	4.2
Tungsten	Clear prismatic	large	light	dark	3.3
Tungsten	Clear prismatic	large	dark	dark	2.6
Tungsten	Satin finish	large	light	light	3.9
Tungsten	Satin finish	large	light	dark	3.0
Tungsten	Satin finish	large	dark	dark	2.3
Tungsten	Enamel	large	light	light	3.4
Tungsten	Silvered glass				6.1
Tungsten	None	large	light	light	3.3
Tungsten	None	large	light	dark	2.1
Tungsten	Silvered glass	small	white	light	2.7
Tungsten	Silvered glass	small	white	dark	2.1
Nernst	Silvered glass	large	white	light	3.1
Moore light	Silvered glass	large	white	dark	2.7

It will be seen that these values differ from the total flux of light or lumens per watt emitted by the source. Thus the tungsten lamp having an efficiency of 0.8 mean horizontal candlepower per watt and a spherical reduction factor of 0.78 will give $4\pi \times .78 \times .80 = 8.85$ lumens per watt against the highest value in the table of 6.1 with a mirrored reflector. This difference in the amount of light given by a luminous source and that available on a working plane is obviously due to the loss in redirecting the luminous rays by means of shades or reflectors and to the absorption of light by the walls and ceiling of the room. This goes to show that the results obtained by means of illumination measurements are much more reliable and of greater practical value than those calculated from candlepower measurements or derived by methods involving the use of the polar diagram. Moreover, it is evident that if data of the former nature are not available due allowance must be made for discrepancies arising from the use of the candlepower measurements in determining illumination values.

Having the value of the average lumens per square foot, which will meet the requirements for the various classes of services, as given in Table 1, and the effective lumens per watt from the various illuminating equipments, Table 2, it is a simple matter to determine the number of lamps for a given installation. As an example of such a calculation the number of lamps will be determined which are necessary to illuminate a store thirty by sixty feet, or an area of 1,800 square feet, with an intensity of 3.5 foot-candles.

If the walls and ceilings are assumed to be light in color, then with tungsten lamps and clear prismatic reflectors these should be obtained 4.2 lumens per watt. Then from equation (1).

$$w = \frac{i = 3.5}{k = 4.2} = 0.833 \text{ watts per square foot.}$$

The number of lamps will obviously be equal to the product of the area and the watts per square foot divided by the watts per lamp, or

$$N = \frac{\text{area} \times \text{w. sq. ft.}}{\text{w. per lamp.}} \ldots\ldots\ldots\ldots (2)$$

By using 100-watt lamps and substitupting we will get,

$$N = \frac{1800 \times 0.833}{100} = \text{fifteen 100-watt lamps.}$$

By combining equations (1) and (2) we may obtain the value of the number of lamps by using the values given in tables (1) and (2) directly as,

$$N = \frac{\text{area} \times \text{foot-candles (Table 1)}}{\text{watts per lamp} \times \text{effective lumens per watt (Table 2)}} \ldots\ldots (3)$$

and by substituting the previous values we have

$$N = \frac{1800 \times 3.5}{100 \times 4.2} = \text{fifteen 100-watt tungsten lamps.}$$

By similar reasoning it will be found that twenty-five sixty-watt or ten 150-watt tungsten lamps will meet the requirements.

Having found the number of lamps

it next becomes necessary to determine their location. One method of doing this is to divide the room into a number of equal areas and place an outlet over the center of each area. With twenty-five sixty-watt lamps we would have seventy-two square feet per lamp; with fifteen 100-watt lamps, 120 square feet per lamp, etc. Thus with 100-watt lamps the best arrangement will be as shown in Fig. 2, where the room is divided into sections ten by twelve feet. and one lamp placed over the center of each section.

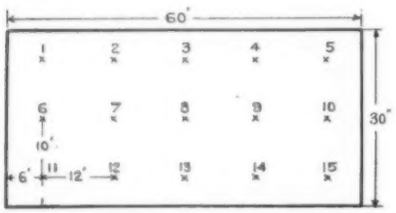


FIG. 2.—PLAN FOR LIGHTING A ROOM 30 FEET BY 50 FEET WITH FIFTEEN 100-WATT TUNGSTEN LAMPS. ONE LAMP IS PLACED AT THE CENTER OF EACH SECTION 10 BY 12 FEET.

These methods and results do not take into account the distribution of the illumination with respect to uniformity, but refer only to the average values. The uniformity of illumination can be obtained by choosing lamps and reflectors which direct the light in the desired manner. Many reflectors have been designed to distribute the light so as to accomplish this purpose. In Fig. 3 is

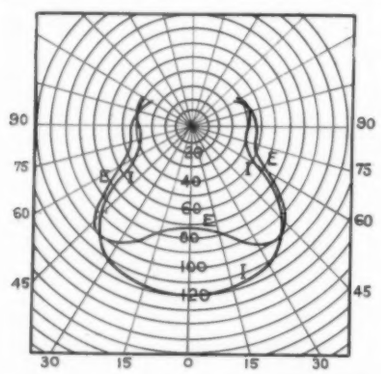


FIG. 3.—DISTRIBUTION OF LIGHT IN A VERTICAL PLANE AROUND A 100-WATT TUNGSTEN LAMP—I WITH PRISMATIC REFLECTORS OF INTENSIVE TYPE—E REFLECTORS OF EXTENSIVE TYPE.

shown the distribution of light in a vertical plane around a 100-watt tungsten lamp when equipped with an extensive type and an intensive type of prismatic reflector. These curves show the candlepower in radial directions only and give no indication of the distribution of illumination. The distribution of illumination on a horizontal plane may be calculated from these curves by use of the equation $E_h = C_\theta(\cos^3\Theta)/h^2$ where E_h is the horizontal illumination in foot-candles at the point in question; Θ the angle which the luminous rays make with a vertical through the source; C_θ, the candlepower of the source of light Θ degrees from the vertical; and h, the height of the lamp above the working plane. The results of such calculations from the curves shown in Fig. 3 are shown in Figs. 4 and 5. Curve *A*, Fig. 4, shows the distribution of illumination on a horizontal plane due to one lamp placed eight feet above the plane and equipped with an intensive reflector.

The ordinates are in foot-candles and the abscissas indicate distances from a point directly beneath the lamp. The illumination is far from uniform. However, if two lamps are placed at the same height and ten feet apart the illumination on the plane between points beneath the two will be nearly uniform as indicated by curve *B*, Fig. 4. It will be seen that the ratio of the distance between lamps to their height above the reference plane is ten to eight, or 1.25 to one. Thus, if this ratio is maintained when the lamps are suspended at other heights, the relative distribution of illumination will remain the same, although the intensity will vary somewhat.

Similar curves for lamps with the extensive type of reflector are shown in Fig. 5. Here the height is six feet, and the distance between lamps is eleven feet. In this case the value of $d/h = 11/8 = 1.83$. Since the general distribution of light from lamps of other types and of other sizes is similar to these when equipped with the same type of reflector it will be seen that the constants 1.25 and 1.83 given above refer to the type of reflector, and may be applied to installations employing any of the commercial types of lamps, when equipped with these types of reflectors.

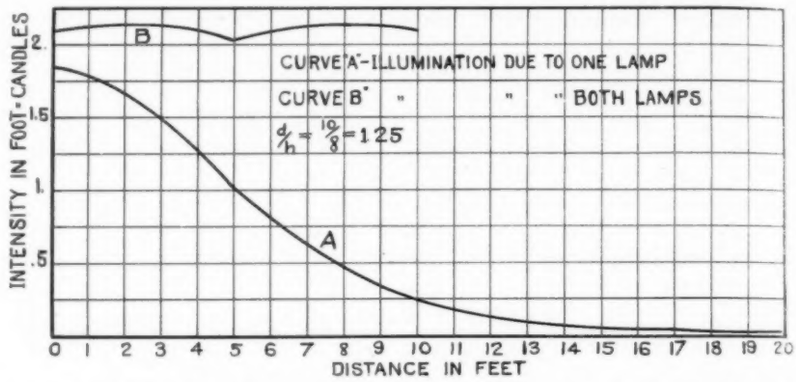

INTENSITY IN FOOT-CANDLES
2
1.5
1
.5
B
A
CURVE A'-ILLUMINATION DUE TO ONE LAMP
CURVE B" " " " BOTH LAMPS
d/h = 10/8 = 1.25
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
DISTANCE IN FEET

FIG. 4.—ILLUMINATION FROM TWO 100-WATT TUNGSTEN LAMPS WITH PRISMATIC REFLECTOR OF THE INTENSIVE TYPE.

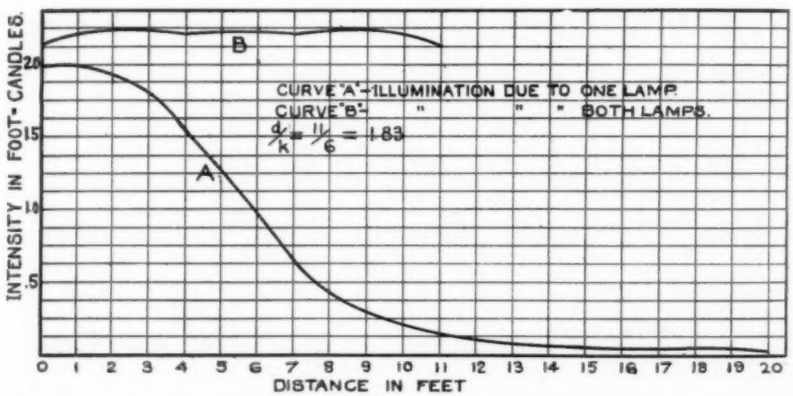

INTENSITY IN FOOT-CANDLES
2
1.5
1
.5
B
A
CURVE A'-ILLUMINATION DUE TO ONE LAMP
CURVE B'- " " " BOTH LAMPS.
d/h = 11/6 = 1.83
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
DISTANCE IN FEET

FIG. 5.—ILLUMINATION FROM TWO 100-WATT TUNGSTEN LAMPS WITH PRISMATIC REFLECTORS OF THE EXTENSIVE TYPE.

It will be seen that the illuminating intensities shown in Figs. 4 and 5 are much lower than those assumed in the installation previously cited. One reason for this is that the direct rays from the other lamps will add to the values calculated for only two lamps, and an-

other is that a considerable part of the light emitted toward the ceiling is thrown upon the working plane by reflection. Thus it will again be seen that where the installation includes more than one or two lamps calculations involving the candlepower measurements are of little practical value other than showing the relation distribution of the illumination.

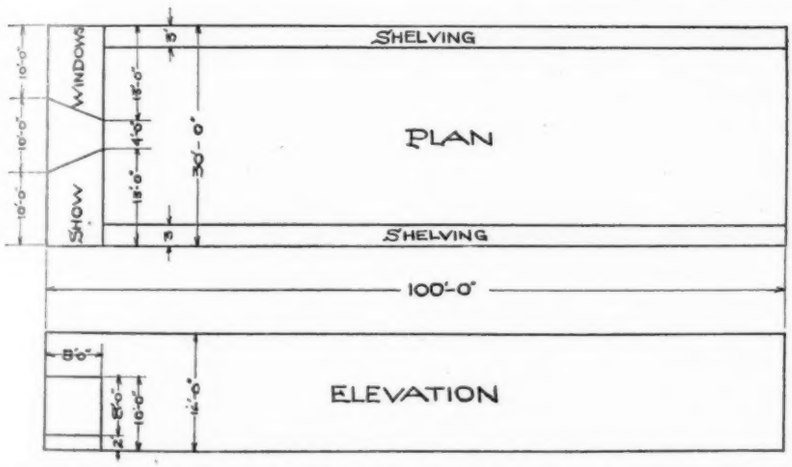
Electricity Displaces High-Pressure Gas for Illuminating an English Skating Rink.

Our English contemporary *The Electrical Review* records an instance in which a high-pressure incandescent gas lighting system was replaced by metallic-filament lamps. This occurred at the skating rink at the White City, Newcastle-on-Tyne, England. The proprietors of the White City after reaching the decision to change over, sent their order to Robson & Coleman, of Haymarket Lane, Newcastle, and it was received by them at 8 a. m. on Wednesday, March 2. Within thirty minutes the employes of the firm were actually at work on the premises. The installation is a permanent one of about 400 lights, and it was finished by 5 p. m. on Monday, the 10th ult.—that is to say, within a period of eight days. The main floor is lighted by means of six large diamonds, each carrying thirty-two lights. The diamond structures, which are about forty feet across diagonally, were assembled complete in Robson & Coleman's own works and then put into place at the building with the minimum of obstruction to the roller skaters.

Chicago Section of the Illuminating Engineering Society.

At the April meeting of the Chicago section of the Illuminating Engineering Society, held on April 14, in the rooms of the Western Society of Engineers, the new method of providing vital matter for discussion was put into effect. As was suggested at a previous meeting, plans for a store to be lighted were sent to each member in advance, with the request that each should work out a scheme of lighting to provide a certain intensity; in this case three foot candles at the level of the counters. Charts are provided on which each proposed scheme could be shown to the other members.

The first plan, presented by J. G. Henninger, representing the engineering department of the National Electric Lamp Association, provided sixteen one hundred watt Mazda lamps provided with Holophane intensive reflectors. For window lighting he proposed the use of four one hundred-watt Mazda and three sixty-watt Mazda lamps with focusing reflectors. The intensity of window lighting was about sixteen foot-candles, requiring about 5.4 watts per square foot. The store proper needed .72 watts per square foot.



PLAN FOR STORE LIGHTING, SUBMITTED TO MEMBERS OF THE CHICAGO SECTION OF THE ILLUMINATING ENGINEERING SOCIETY.

An interesting arrangement, proposed by Geo. C. Keech, involved the use of a combination mercury vapor and tungsten lamp. In this unit the mercury vapor lamp is bent in a circle, at the center of which is a tungsten lamp. The resultant effect of the two lights is something very near to daylight. The maximum intensity of this light is about 300 candle-power, but the distribution is such that for nearly forty-five degrees on every side of the vertical, the illumination is constant. The intensity secured would be about 3.15 foot-candles at the counter.

H. B. Wheeler proposed the use of four seven lamp clusters, using one hundred-watt Mazda lamp with National X-Ray reflectors. For window lighting he designated twelve sixty-watt lamps with scoop reflectors. Plans were also presented by C. A. Howe, J. P. Smith and J. R. Cravath.

Change in National Electric Code.

Commissioner Thompson of the Department of Water Supply, Gas and Electricity, of New York city, announces the following amendment to Rule 21-d of the National Electrical Code, the same to take effect immediately:

Omit the portion of the second paragraph reading as follows:

"Special permission may be given in writing by the Inspection Department having jurisdiction, for departure from this rule, in the case of large chandeliers. (For exceptions, see rule on theatre wiring and list of fittings for rules for electric signs)."

and substitute therefor

In cases where wiring equal in size and insulation to No. 14 B. & S. gauge approved rubber-covered wire is carried direct into keyless sockets or receptacles, the circuits may be so arranged that not more than 1,320 watts will be dependent on the final cutout, provided, however, that the location of sockets and receptacles is such as to render unlikely the attachment of flexible cords thereto.

President Diaz on Power Development.

In the recent message of President Diaz to the Mexican congress the subject of the development of the water resources was touched upon. President Diaz said in part:

"It is necessary to secure a solid legislative basis for all irrigation and motive-power enterprises, which should also render feasible plans of colonization in our country. With these objects in view the draft of an organic law was presented to congress on December 4, 1909, regulating the section of the constitution, which empowers congress to determine which are the waters that are subject to federal jurisdiction and to frame laws for their utilization. In the meantime applications for concessions have increased to such an extent that during the last six months they numbered 109. Of this number eleven applications have been favorably passed upon up to this time." D.

TELEPHONY—TELEGRAPHY, and WIRELESS.

Cable Work.

In an interesting paper read before the Spare Pair Society of the Bell Telephone Company of Pennsylvania on March 16, W. A. Wurst, of the plant department, describes a method of making cable transfers as follows:

"We have recently completed a series of transfers in the Germantown district of over 1,400 lines with scarcely any trouble, and absolutely no permanent trouble that lasted over an hour after it was discovered. A great deal of the success of these transfers is due to the co-operation of the wire chief's force.

"One transfer of 660 pairs of wires carried over one-seventh of the stations in the Germantown district, and was made without one complaint. To make one 440-pair transfer, we had to make it in three parts, and jumpers for the second and third portions could not be run until each transfer made room on the frame for the succeeding one. This job took forty-eight hours' continuous work by two gangs of cable men, in twenty-four-hour shifts.

"The old method of throwing a section of cable for trouble was to half tap the new section in one manhole, to go to the other manhole and transfer it after making two tests, then come back and cut out the half tap. This was slow and expensive, and the trouble was likely to make the test inaccurate.

"Our present practice is to place a splicer and tester in each manhole, then put tone or buzzer on a pair of wires on the outside layer of the old cable, when the tester in the other manhole finds the pair. The finding after this is comparatively easy, as the man sending tone follows the layer carefully, and the other man simply has to follow the layer and knows what the next pair is; he simply goes on to it to verify it. Each pair is found alternately in the old and new sections, and spliced through the new section at each manhole by the splicers. As soon as found, this work has been gotten down so that trouble is rarely occasioned.

"The use of colors in the large feeder cables is, I believe, peculiar to Philadelphia; while I understand it is a slightly extra expense, still, when cables are properly installed and colors kept straight, it saves a very large amount of time.

"In setting in a stub, for an instance, we can tap it in on a fifty-five-multiple without the use of a tester. In throwing a section, we can throw one color at a time. If a pair of wires is in trouble in a cable, we know what color to look for, instead of having to go through the whole 440 pair. In cutting in a new box, we know by the multiple what color to test in.

"In making a test for a transfer, we test only one color at a time, so that tester on the frame has only fifty-five pair of wires to run over at a time, instead of having to run over the entire 440 pair."

The Telephone in Construction Work.

The telephone is just receiving proper recognition as one of the most useful minor auxiliaries of a construction plant. Probably this increase in its use on temporary service, says the *Engineering Record*, has been due to the precedent afforded by the United States Reclamation Service, which maintains a telephone department that has proved its worth on many occasions. On most contracts a line is run from the office to the nearest long-distance connection, but such a service is merely an incident in what the telephone can do for the contractor under favorable conditions.

If the job, for example, involves steam-shovel work with a haul of several miles to the dumps or the embankments where the material is deposited, one of the important aims of the contractor is to keep the steam shovels busy all the time. This involves good train service, which means, in turn, a complete control of the whole system of tracks from the loading points by the shovels to the dumps or embankments. This control is best exercised by telephone, as a number of contractors have already found out.

In the same way, where important apparatus is working at several points, and any shutdown should be restricted to the absolute minimum time possible, telephone connections by which repair parts and mechanics can be hurried to a machine in trouble may save its entire expense in preventing heavy losses on even one such occasion.

Contractors whose operations must be carried on where floods will cause damage have also begun to use the telephone in order to secure early notice of approaching freshets. Such a service enables operations to be conducted with greater assurance of success than where fear of flood is ever present.

Automatic Telephone Service for Chicago.

The Subway Telephone Construction Company, Chicago, Ill., which recently secured the telephone franchise of the Illinois Tunnel Company, announces that it proposes to install and have in operation, not later than June 1, 1911, a complete automatic telephone system in Chicago.

The first equipment, it is claimed, will be installed in the business district and as the service increases exchanges will be established in residence districts.

Regarding rates, the company asserts that after 10,000 telephones have been placed in operation the charge for unlimited service will be as follows: 10,000 to 15,000 telephones, $1.75 per month; 15,000 to 17,500 telephones, $3.50 per month; 17,500 to 20,000 telephones, $5.25 per month, and 20,000 telephones and over $7.00 per month. It

is also stated that no matter how many subscribers are secured the charges will at no time exceed $84 per year for business telephones and $50 per year for residence telephones.

3,000-Mile Wireless Test by United States Navy.

The Navy Department of the United States is soon to give a long distance test to its wireless telegraph apparatus. It is proposed to make this test between the coast of Liberia and the station at Brant Rock., Mass., from which station the previous tests were conducted.

The cruiser Birmingham, from which the message will be sent, sailed for Liberia a short time ago on a rush errand in connection with the threatening attitude of the tribes on the south border. Orders have now been issued for the gunboat Des Moines to proceed to Liberia to relieve the Birmingham in order that the latter vessel may prosecute the wireless experiment from points in the South Atlantic off the African coast. The Salem will take another position about 1,000 miles distant from the Birmingham and the ships will try to communicate directly between themselves, with the Brant Rock station direct, and finally to that station through a chain of wireless stations.

An Address by Telephone.

One of the features of the recent meeting of the Fort Worth Ad Men's Club held in the dining room of a hotel at Fort Worth was an address delivered to them by long-distance telephone from Dallas by Frank B. Knight of Dallas. There were eighty-five guests at the luncheon, and at the plate of each was a desk telephone. Mr. Knight sat in his office thirty-five miles away, and at the appointed time he gave the signal to the guests which was by ringing a tiny bell upon each instrument. Each guest placed a receiver to his ear and listened to Mr. Knight's address. D.

Powerful Wireless Outfit for British Warship.

The famous British Warship *Dreadnought*, prototype of a class of vessels now bearing its name, is now undergoing her first refit at Portsmouth Dockyard and is being equipped with a new wireless outfit of great power.

Anticipation of Trouble in Telephony.

Under the above caption R. T. Cloud, of Dallas, Tex., writing in *The Southwestern Telephone News*, gives three methods of anticipating trouble in the telephone operation: *a*, By exchange trouble records; *b*, by regular methods of testing; *c*, by proper construction methods. Mr. Cloud's views are given in part as follows:

Trouble Records.—Every exchange has been provided with the necessary forms, etc., and in most of them a record is kept of both switchboard, line and instrument troubles. At the end of the month carefully subdivide each class of trouble and see what your percentage of each class of trouble is and find out why.

If you find that on your switchboard a large percentage of your cords are going in trouble, it may be that the windows next to the board are being left open on damp nights or that they are being improperly handled by the operators; have a talk with the chief operator about it; perhaps there are some points she has overlooked and will be glad to help you out.

You may find that you are having a good many tangled cords reported; an apparently insignificant trouble, but one that will delay service to an appreciable extent and put a quantity of expensive equipment out of service until corrected. Most likely the cord weights are battered until the roller will not turn, causing this class of trouble.

If keys are found to be sticky, polish the plungers with a cloth that has been previously dipped in hot paraffin wax and allowed to cool. If you have a great many noisy connections a little Bon Ami and elbow grease will soon put your plugs in shape to prevent this. You will be surprised on going over your old switchboard trouble tickets at the number of troubles that you could have anticipated and cleared before the trouble actually existed.

The same process applies to the outside. If you are having a large amount of any class of troubles, profit by your past experience and correct same. You won't work yourself out of a job, but rather into one; a better one at that.

If you are having trouble with unsoldered bridle wires, what is easier for a repairman to do than to solder the entire bunch while he is at a cable box on trouble? Then he will save himself another trip. Or, when a pair of wires are too slack, it is easy to knock out a cross and go on, but far easier in the long run to pull them up, obviating the necessity of another trip, which is annoying to yourself and expensive as well as annoying to the company.

Cable trouble may often be anticipated by noting date and troubles on the card as each pair goes bad and when several pairs go bad in succession prompt action may catch it before other pairs are affected.

Testing.—The second means of anticipating trouble is that of testing. Be on the aggressive. It is said that a man never looks for trouble, but he finds it. Now is your chance to try this out without involving serious injury to yourself.

The cord and line relays should be tested at regular intervals. When trunks are used they should be tested daily.

Tinsel cords on the toll board should be tested twice per week for noise and cut-off listening to a constant, but not loud, sound. Tone test with a 500-ohm ringing coil in series is excellent for this purpose.

The toll keys may be tested for cut-off by the same means. Local keys can be tested for cut-off by connecting a receiver to tip and ring and putting pressure on either side of the key, at the same time listening for click of cut-off.

An insulation test of outside lines is the very best kind of trouble forecaster. It should be made monthly and trouble cleared. This gets tree trouble, dirty carbons, bad condensers, etc., in time to precent complaint from subscriber.

Construction Methods.—The third and last method, that of proper construction, is by no means the least. Do your work right. When you run a jumper, solder your connection at once. When you adjust a relay tighten the nuts so they will not work loose. When you hook up a bridle or entrance wire, solder it before you leave the job. Don't say you haven't the time. It is just that sort of thing that prevents you from having the time; take the time and you will have the time in future.

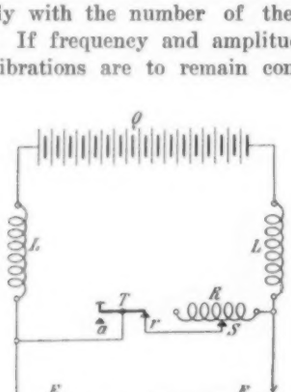
Every piece of apparatus installed should be placed with an eye to its probability of getting into trouble also as to its accessibility in case of such.

A close observer, by taking advantage of the old adage, "a stitch in time

saves nine," can prevent more trouble than half a dozen men can clear and it is his duty to the public, the company and himself to do so.

Method of Simultaneously Starting Several Arcs for Signaling in Wireless Telegraphy.

If electrical vibrations produced by means of an arc in the well-known manner are to be utilized in wireless telegraphy, it is necessary, in order to obtain large amounts of energy in the vibrating circuit, to employ several arcs in series. But such series connection presents technical difficulties which increase rapidly with the number of the arcs used. If frequency and amplitude of the vibrations are to remain constant

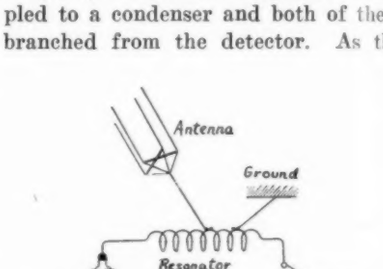


CIRCUIT DIAGRAM.

all the arcs must be exactly equal in those factors that determine the vibrations, and this condition is difficult to attain in practice. It is scarcely possible to maintain the arcs constant during any length of time on account of the unavoidable wear of the electrodes and their periodical adjustment necessitated thereby. The starting of the arcs is usually also difficult, as the electrodes have first to be brought into contact and then set at the required distance. Prof. W. Peukert describes a method which will avoid these drawbacks and in which the wear and consequently necessary adjustment are greatly reduced by the fact that the arc burns only while the signal is given. The essential features of the new method are shown in the accompanying illustration, which is a diagram of the experimental circuit arrangement. In the figure, *Q* is a source of current, *L L* are inductive resistances serving at the same time as choking coils, *T* a key with working and rest contacts *a* and *r*, *R* a working resistance with sliding contact *S*. A vibrating circuit consisting of capacity *C* and self-inductance *L1* is connected to the electrodes *E E*, which are joined in series. When the key *T* rests on contact *r*, the circuit is closed through the inductive and the working resistances. When the key is depressed on the working contact *a*, this circuit is suddenly interrupted, and the inductive resistances and capacity produce a sufficiently high tension to bridge the gaps between the electrodes, so that current passes and vibrations are generated. The arc will cease immediately when the key returns to its position of rest. The duration of the vibrations can thus be regulated at will by the manipulation of the key and telegraphic signals produced. The arcs burn only during the time of signaling, and the wear and detrimental heating of the electrodes are thereby reduced. As in this method the tension for starting the arc is dependent on the suddenness with which the shunt circuit is interrupted, the key should be equipped with an arrangement causing a very quick break, such as a vacuum interrupter. The working resistance *R* may be adjusted so that there is a constant load on the current generator. This is particularly important when a dynamo is employed as the source of current. Extensive tests have shown this method to be perfectly safe and reliable in operation.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), March 3.*

A Very Sensitive Electrolytic Detector Operating Without Auxiliary Electromotive Force.

Some time ago a new kind of detector became known, which permits the detection of electric waves directly in a telephone receiver, without the use of an auxiliary source of electricity. These detectors are formed by combining pyrites or crystals of simple bodies with very fine metallic points, the contact being subjected to a suitable mechanical pressure. The best known substances belonging into this class are carborundum, pericon and silicon. The detectors are highly sensitive, but get out of order very easily. Prof. Paul Jégou describes an electrolytic detector constructed by him which also operates without an auxiliary source of electricity. Its characteristic is the special metal constituting the cathode or inactive electrode, which consists of mercury holding pure tin in solution. Water acidulated with sulphuric acid is poured on the mercury, which occupies the lower space of a cylindrical glass vessel. A platinum wire serving for exterior connection enters the glass vessel through the bottom and is in contact with the mercury-tin electrode. The sensitive point, which is immersed in the acidulated water, is like those employed in ordinary electrolytic detectors. By connecting suitable telephone receivers, preferably of high resistance (about 7,000 ohms), to the poles of this detector and connecting the detector between antenna and ground, good results have been obtained. A syntonizing arrangement, which gives excellent results, consists in joining the tuning resonator in series with the detector and telephone receiver, as shown in the accompanying illustration. This connection gave distinctly better results than that generally adopted, in which the resonator is coupled to a condenser and both of these branched from the detector. As the

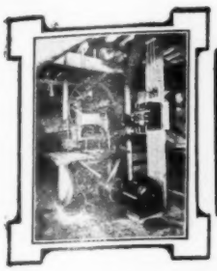


CIRCUIT FOR SENSITIVE ELECTROLYTIC DETECTOR.

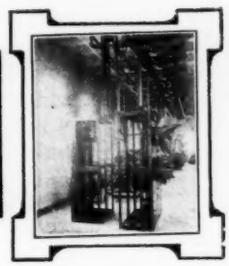
electrolytic detector dscribed is absolutely insensitive to shocks and vibrations, it is readily portable and always in operating condition.—*Translated and abstracted from La Lumière Electrique (Paris) March 19.*

American Bell Telephone Company Wins Suit.

Judge Hale, of the United States Circuit Court, ordered a verdict for the defendant in the suit of the National Telephone Manufacturing Company against the American Bell Telephone Company to recover $500,000 damages for alleged malicious prosecution of suits to prevent the alleged infringement of patents relating to telephone instruments. The defense contended that it had reasonable cause to believe that it could maintain the suits. An auditor found in favor of the Bell company and Judge Hale sustained the findings.



Industrial Power



THE DEPRECIATION AND MAINTENANCE OF ELECTRICAL EQUIPMENT.

BY GEORGE W. CRAVENS.

There are few questions concerning which users of apparatus of any sort disagree so often as upon depreciation and its related factors. Frequently, it must be admitted, this is due to an almost total lack of experience and fundamental information upon which to base an opinion. The balance of the time these disagreements are nearly always the result of the failure to consider the effect of local conditions upon the operation of the apparatus, and consequently its life or period of satisfactory service.

To adopt a general rate of depreciation as being suitable for all kinds of apparatus, or for any one kind under all conditions of service, is evidence of unfamiliarity with the subject, to say the least. This matter is of such great importance, in its relation to the economics of the electrical business generally, that it is worthy of much more universal study than it has heretofore received.

Depreciation, maintenance and amortization are very closely related factors, so let us see the meaning of each of them and their relation to each other. Strictly speaking, depreciation is a reduction of value through age and other causes. But the general term means more than that because it applies to a process. It means also a provision against certain contingencies. Maintenance means those repairs, alterations or substitutions which are necessary to offset depreciation and keep the equipment in condition for satisfactory service. It should not be confused with betterments or improvements, however, as is sometimes the case.

The relation of upkeep to depreciation is obvious, because the more care we take to keep our equipment in first-class condition the more we add to its useful life. And right here let us distinguish between the valuation of a piece or set of apparatus and its cost to us up to date. The real value of a thing might be only a fraction of its cost to us.

For example, a generator might have cost $5,000 when new, and have had two new commutators, a new set of armature coils, new field coils and connections and new linings for the bearings up to the time of its revaluation. These replacements may have cost $6,000, including labor and transportation, thus bringing the total cost of the generator to us up to $11,000, and yet its present value based upon depreciation tables alone may be only $3,000. But the actual useful life of the machine may have been doubled or tripled by spending this amount on its upkeep, and its rate of depreciation to zero value should logically be modified accordingly.

Amortization is closely related to depreciation through being based upon it. This consists in the establishment of a sort of sinking fund through the setting aside each year of a sum of money, just as if to cancel a debt. In this case it means to set aside enough each year so that with compound interest it shall equal the cost of the apparatus when the end of its assumed useful life has been reached. The sum to be set aside may be determined by the formula

$$d=\frac{100\,r}{(1+r)^n-1}$$

in which, d=rate of depreciation expressed as a percentage of the first cost, r=rate of compound interest, and n=the assumed life of the apparatus in years.

The above is based upon the assumption that the apparatus will be valueless at the end of n years, but as a matter of fact it will have at least a scrap value. Taking this into account our formula becomes

$$d=\frac{100\,r\,(1-b)}{(1+r)^n-1}$$

in which, b=the ratio of the value of the old material to that of the apparatus when new.

For example, suppose we want to put a small power plant at a mine which we believe will be exhausted in ten years, and the plant will cost $5,000. Assuming that the scrap value of the equipment will be $750 when its useful life is ended, how much must we set aside each year at three per cent compound interest to amount to $5,000 minus $750, or $4,250, at the end of ten years? In this case $b=\frac{750}{5,000}=0.15$, hence

$$d=\frac{100\times.03(1-.15)}{1+.03)^{10}-1}=\frac{100\times.0255}{1.344-1}=\frac{2.55}{.344}$$

=7.41 per cent.

And, 7.41 per cent of $5,000 equals $370.50, which, if set aside annually for ten years at three per cent compound interest, will equal $4,250 at the end of that period. This fund will cover the assumed depreciation, but a "maintenance fund" should also be established independently, to be drawn upon from time to time for necessary repairs, renewals, etc.

Referring again to depreciation proper, in its broadest sense, we find not only a diversity of methods used in calculating this factor, but also very few rational methods in use. The average engineer or manager in charge of an electrical installation has a very decided opinion as to the value of his own method of estimating depreciation, and he usually feels justified in this because his opinion is founded upon his own experience. But upon questioning many of them we have been told that a blanket annual depreciation of five, seven and one-half, or ten, or some other per cent is allowed upon the entire outfit.

The exceptions to this rule are nearly

all among the large public service corporations, but even here a fixed annual percentage is followed for each type of apparatus instead of a variable rate based upon the actual conditions. The time is coming when accounting methods must be modified along rational lines, so let us examine the philosophy of this matter and see wherein present methods are lacking and how they may be improved upon.

The value of an installation or equipment equals 100 per cent when new. After a while we look at it again and find that it has depreciated in value. Why is this so? Everything seems to be all right, the operation is as good or better than when starting up, nothing has worn out or broken down, efficiency is up to normal, and yet when the insurance man or a possible purchaser comes along, or we make our annual inventory, the value of the apparatus is placed at less than it cost. And this is equally true, but in less degree, if the apparatus has never been used since it was installed.

The reason is very simple, although it is based upon many factors. Every day or hour that a machine is operated reduces its total useful life by just that amount, if there be no appreciable change in it. And every day which passes after a machine is built increases the liability of its being superseded or reduced greatly in value by the development of some newer and better device, or by changes in the market for the apparatus or its output. There are other points, such as wear and tear in service, the fact that a machine is second-hand as soon as used, etc., which have a direct bearing upon its value, and some hidden flaw or imperfection might develop, so this must be insured against. This latter should be directly taken care of by the maintenance fund, of course, but its depreciating influence will be apparent. These form some of the contingencies against which we must provide by "depreciating the value" of the apparatus from time to time.

It might be noted here that the term "value" as used in connection with depreciation applies to the "physical value" rather than to the "earning value" of the equipment. It is easy to see that the earning value of a plant might increase as its physical value diminished. For instance, a certain company installed a power plant in a new and growing city in the West, and anticipated the future demands for electric power by installing apparatus of nearly four times the capacity then required. During the ten years that have passed since starting this plant the demand for power has increased, until now the plant operates at about twenty-five per cent overload for a part of each day, and at practically full load during the balance of the twenty-four hours. This is a hydroelectric plant, and an unusually good investment, but if sold at a price based upon its earning value at the present time it would bring more than twice its original cost, whereas if sold according to its age or "depreciated value" it would bring about one-half of its first cost.

According to some methods of determining depreciation this plant has depreciated sixty-six and two-thirds per cent, by others thirty-three and one-third per cent, and by still others at various percentages between these limits. As a matter of fact, the amounts spent for maintenance in this plant have been so liberal that the plant is practically as good as new, and good for an almost indefinite useful life. But the amortization fund was based upon twenty years, with a sinking fund for upkeep maintained separately, so the owners will have cancelled the cost of the original installation in ten years more and still have a plant practically as good as new. Here we have a good illustration of the effect of adequate maintenance upon depreciation.

The reverse of "depreciation" might be called "appreciation," meaning "increasing in value." The term has been used in this sense by some writers on cost finding and factory acounting, and it is a good term. Some managers follow the practice of carrying all equipment, still in service, on their books at cost year after year on the principle that "it would cost that much to replace it." Others go still further and add to the first cost all amounts paid for upkeep and replacements. These are "appreciation" carried to extremes and give "watered" valuations to the equipment. This practice is very bad policy and is to be condemned.

So we see that it is necessary to "depreciate" the value of our equipments and to do it in accordance with some rational method, otherwise we do not know if our interest charges, insurance, taxes, valuations, etc., are fair, or if we are receiving "adequate" return on our investment, etc. And, it might be said in passing, it is just as wrong economically to jeopardize the future of an enterprise by taking too great a portion of the earnings for dividends, instead of putting them into reserve funds, as it is to discourage investment by paying no dividends. Many a worthy undertaking has "died young" through failure to provide for the future while upkeep and other expenses were still small. Now, what method of depreciation shall we consider as being "rational" enough for adoption? Let us see first what has been done and is being done, and why some methods are good and some are bad.

The fire insurance companies have paid more attention to this question of depreciation than any one else, naturally, and they have laid down very complete and specific rules for the guidance of their adjusters. Their practice is almost universally based upon a sort of "sliding scale" of percentages. For example, on machinery of certain classes depreciation is figured at twelve and one-half per cent for the first year, eight per cent the second year, five per cent the third, two and one-half per cent the fourth, and two per cent the fifth and every year thereafter. Again, other kinds of machinery are figured at twelve and one-half per cent the first year, ten per cent the second, seven and one-half per cent the third, and five per cent the fourth and every year thereafter. Other similar rates prevail.

This is a very good method and one which may be applied to many electrical equipments, but only with careful discrimination. As to the exact percentages which should be taken, these will be determined by the nature of the apparatus, service conditions, provisions for maintenance, probable obsolescence, etc., all of which will vary in each instance, and which must be passed upon by experienced operators or engineers.

Turning now to the public service corporations, we find nearly all of them using equal annual percentages for the rates of depreciation for each class of apparatus. And the rates allowed by different concerns vary through wide ranges, as shown by the accompanying table, indicating an apparent attempt at basing the assumed life of the equipment upon local conditions. And this is good, if true. But investigation shows that variations are frequently

due to honest differences of opinion, as in the case of the recent Milwaukee Electric Railway and Light Company investigation. However, it is a fact that most of the more progressive corporations do base their depreciation factors upon local conditions, rather than upon broad assumptions, although they make the percentage the same for each year of the assumed life of the apparatus. And this is strange, too, in view of the facts.

Every electric railway engineer, for instance, knows that it is practically impossible to keep the "going" value of this equipment, as a whole, up to eighty-five per cent of its cost. In fact, the cost of maintenance to keep it up to seventy-five per cent is frequently almost prohibitive, and in some cases sixty-five per cent is a fair going valuation, although this is about the lowest practical state of "disrepair" for ordinary operation. The average is around seventy-five to eighty per cent of the cost when new.

TABLE I.
PERCENTAGE DEPRECIATION PER ANNUM.

ITEMS.	Chicago Traction Commission	Chicago Union Traction Co.	Milwaukee Electric Railway & Light Co.	Wisconsin Railroad Commission	Average English	Average Scotch Practice	Philip Dawson	Stone and Webster	Industrial Power Plants	Professor G. F. Gebhardt	Miscellaneous Sources
Buildings	..	2	3	2	2.5	2.5	1-2	2	1-2	3	2
Boilers	3.5-10	6.6	7.5	6.6-8.5	5	5	8-10	5	2.5-3.3	4-6.6	7.5
Steam Piping	3.5	6.6	7.5	5	5	5	8-10	5	2.5-3.3	5-8	5
Auxiliaries	5-10	6.6	5	6.6-8.5	5	5	8-10	5	4-6.6	3-5	7.5
Steam Engines	3-10	6.6	5	5-6.6	5	5	4-6	5	2.5-5	4-6.6	5
Steam Turbines	..	..	5	..	5	5	7-9	5	2.5-5	4	4
Belted Generators	5-10	6.6	7.5	5	5	5	5-10	5	6.6	3.3-4	7.5
Direct Connected Generators	5	6.6	7.5	5	5	5	4-8	5	4	3.3-4	5
Wires and Cables.	2	6.6	5	2	5	3	3-5	5	4-6.6	5	5
Switchboards, etc.	2	6.6	5	2	7.5	5	8-10	5	2-5	..	5
Rotary Converters	..	6.6	5	5	5	5	8-10	5	4-5	4	5
Transformers	..	6.6	5	5	5	5	5-6	5	3-5	4	5
Motors	5-10	6.6	5	5	5	5	5-8	5	4-6.6	5	5
Storage Batteries.	..	6.6	10	..	5	5	9-11	5	5-10	6.6	10
Overhead Systems	..	10-14	7.5	..	..	3	4-8	10-14	5-10	..	10
Cars	..	5-8.5	6-7.5	5-6.6	10	7.5	4-6	5-8.5	..	..	7.5
Trackwork	..	7.75	7.5-12	5	5	8	7-13	7.2	..	..	7.5
Shop Equipment	3-10	5	7.5	3.3-10	7.5	7.5	12-15	5	4-10	..	7.5
Supplies and Miscellaneous	5	..	5	..	5	7.5	1.5-2	..	5	..	5

Now, as this reduction of value, with its consequent increase of maintenance expense, is greatest toward the end of the useful lives of the individual items of the equipment, we should in all fairness increase their rates of depreciation to correspond. Take the item of special track work, for instance, so long as we have mentioned the railway field. The useful life varies from eight to twenty years in different places, with the average probably around twelve and one-half years. As soon as it is placed in service it becomes "second-hand" material, and its value takes a big drop. During the first few years of its life the wear is slow but constant and fairly uniform. Then there is a rapid and accelerating increase in deterioration, and the ending of its useful life. So long as this is known, why not base the depreciation factor upon a similar sliding scale? And the same principle applies to all electrical apparatus.

Periodic appraisals have been suggested as one way of determining depreciation, and this is a good method, but it does not allow of predetermining a fair rate for accounting purposes. The practice of making periodic revaluations, based upon physical conditions and probable obsolescence, is followed very satisfactorily by some small lighting companies, small manufacturers, and private power plant owners. But it has proven bulky and expensive when tried by large operators, electric railroads and manufacturers, even when done in conjunction with the annual inventory, so practically all of those who have tried it have reverted to the annual percentage basis. Nevertheless, this method has much in its favor, and might be worked out along some practical line by accountants of wide experiene in such matters. Its great value would lie in giving us the benefit of the effect of maintenance on the increased useful life of the equipment.

So long as the engineers or management of each concern have a free hand, just that long will there be a difference of opinion. And this is to be expected. But would it not be worth while and strictly within the provinces of our great national engineering societies to take up this matter of depreciation, with its allied factors, and make an effort to develop some rational system which could be recommended? It is obvious that the definite percentages used for one installation might not, and probably would not as a whole, apply to any other installation because of the infinite differences in the equipment and service. But the writer believes that a system based upon a sliding scale, first diminishing and then increasing the percentages per year, could certainly be evolved which would be more rational than any other system at present in use. And, too, this would allow the accountants of the companies to make their calculations just as readily as with a uniform or equal rate of depreciation. An important object in figuring depreciation is to have a fair basis of valuation, and this method would lend itself to that very nicely.

To illustrate the above principle, let us take the case of an electric mining locomotive. The average useful life of such a machine will be from twenty to twenty-five years. Assuming twenty years, the rate of depreciation on a straight basis would be five per cent per annum, and this is the rate commonly assumed. But let us analyze this and see where we come out. The useful life of the motors will not exceed fifteen years, and will average nearer twelve years, but experience shows that armatures seldom last over six years without extensive repairs, and burnouts in both field and armature coils are not uncommon. So we see that to allow but five per cent from the very first is not a fair rate of depreciation for this service.

Controllers, wheels, resistances, headlights, brake shoes and other attachments are subject to rapid deterioration, and these, together with the fact that the locomotive becomes a second-hand device as soon as put into service, will surely reduce its value fifteen per cent during the first year of its service. Also the factor of depreciation due to accident would probably be high in this kind of service, but we can take fifteen per cent as fair for the first year. During the second year the value would drop ten per cent, the third year about seven and one-half per cent, the fourth six per cent, fifth five per cent, sixth four and one-half per cent, seventh four per cent, eighth three and one-half per cent, ninth to sixteenth, inclusive, three per cent each, seventeenth three and one-half, eighteenth four, nineteenth six, and twentieth seven per cent. These figures are only approximate, of course, and must be varied to

suit actual conditions in each case, but any one who has seen locomotives over about twelve years old limping around in mines with broken and poorly patched frames and controllers, many parts and fittings missing, and sounding like threshing machines in distress, not to mention their pyrotechnical display, will agree that deterioration is pretty apt to accelerate from that time forth.

It costs too much to keep the going value up to even fifty per cent in most mines after a locomotive has been used twelve or fifteen years, so the depreciation percentages given are really conservative. In the mines of the large operators the equipment is in fairly good condition longer than in small mines, but the average will be as above stated. This is not due to any fault on the part of the makers of the apparatus, but rather to the poor class of help employed and to the fact that the majority of mines are comparatively small and the supply of coal limited, so it does not pay to operate on a "permanent" basis like a public service corporation or a manufacturing establishment.

Now let us consider this matter of depreciation from the standpoint of those who prefer the equal annual percentage basis of accounting. In any large installation, and in less degree in small ones, nearly every kind of apparatus will be found operating under widely varying conditions of service. Some will be on extra heavy or severe duty, others normal, and still others on very light or intermittent duty. So, instead of allowing one percentage or rate of depreciation, or term of useful life, to all motors or generators, or whatever it might be, let us divide our equipment into at least two classes. The natural line would fall between light and intermittent service on one hand and heavy and continuous on the other. Taking all of the commonly used rates, together with such other data as was available, the writer has compiled the accompanying Table II on the basis of two classifications according to service. It will be noted that allowance has been made in each column for variations to suit local conditions, but "covering" percentages have been determined in both classes.

TABLE II.
PERCENTAGE DEPRECIATION FOR GIVEN SERVICE.

Items of Equipment.	Light or Intermittent Service.	Heavy or Continuous Service.
Boilers, Water Tube	4-6.6	5-8.3
Boilers, Fire Tube	5-6.6	6.6-10
Piping, Steam and Water	4-5.5	5.5-8.3
Auxiliaries, Steam	3-5	4-6.6
Engines, Steam	4-5	5-6.6
Turbines, Steam	3-4	4-5
Generators, Belted	4-6.6	5-8.3
Generators, Direct Connected	3-5	4-6.6
Wires and Cables	3-5	4-6.6
Switchboards and Instruments	2-5	5-8.3
Rotary Converters	3-5	4-6.6
Transformers	3-5	4-6.6
Motors, A. C. and D. C.	4-6.6	5-8.3
Storage Batteries	5-6.6	6.6-10
Overhead Systems	4-10	8.3-12.5
Cars and Equipments	5-8.3	6.6-10
Track work, Ballast, etc.	5-8.3	7.5-12.5
Shop Equipment, Tools, etc.	5-10	7.5-15

As to the actual amounts which should be set aside in each case for depreciation and maintenance, that is manifestly beyond the scope of this article. But the amounts can readily be determined by the formulas given earlier herein, if equal annual sums are the preferred method of accounting. If the sliding scale or variable method is adopted as being more rational, then it becomes a comparatively simple problem in compound interest. Statistics show that in the case of electric railways these items run from twenty per cent to thirty-five per cent of the gross earnings. Lighting installations run much lower, however. There must not be confused with cost of operation, extensions, interest charges, insurance, etc., as before stated, for with these added the allowances would equal 100 per cent minus the net profit. And the latter might be zero, or even take the form of an assessment on the stockholders.

This problem of depreciation, including its allied factors, is one of vital importance to users of other kinds of machinery as well as electrical, and will undoubtedly receive more attention as business develops. The only satisfactory solution will be the result of study and discussion on the part of experienced engineers and operators, so any criticisms which this article may bring forth should be helpful and advance the interests of all concerned. If it is shown that the variable or sliding scale method advocated by the writer is fundamentally wrong, the earlier it is done the better it will be. But, in any case, it is hoped that more data will be forthcoming, and that the experiences of those who have had occasion to make changes in their methods of accounting may be put upon record, with the reasons for such changes, and made available for all of us.

Short-Circuiting of Turbo-Alternators.

A paper on the short-circuiting of turbo-alternators was read on March 10 last by Miles Walker before the Institution of Electrical Engineers, England. The author showed that the forces acting on the armature end windings of a turbo-generator, due to short-circuit, may be extremely large, as the momentary short-circuit current of a fully excited machine may use twenty or thirty times the full-load current, and in the past considerable trouble has been experienced owing to the destruction of such end windings following on short-circuit or bad synchronizing. The paper described various modern methods of staying these windings as adopted by different firms.

Gas-Engine-Driven Electric Installation for Australian Mine.

In connection with the reopening of the old Chiltern Valley and Southern United mine, Rutherglen (Victoria), for working the lower end of the Great Southern Cross lease, the London *Electrician* says it has been decided to employ electric power, and that contracts have already been let to Alex. Cowan & Sons for supply of two 100-horsepower suction gas engines, and to Siemens Bros. Dynamo Works for the electric plant. All pumping, winding, puddling and underground traction will be effected by electricity.

Electric Power in Brazilian Mills.

Fabrica Rink, the largest woolen mill in Rio de Janeiro, Brazil, and the only one of consequence in the district, now operating 1,200 spindles and 104 looms, will shortly make new installations, bringing the total up to 1,900 spindles and 132 looms. Electrical installations have been ordered and the factory will be operated entirely by electric power. About the same time installation will have been made in the only one of the cotton mills of the Federal district which remains to adopt electric motive power.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

CALUMET & SOUTH CHICAGO.

The Calumet & South Chicago Railway Company has issued its report for the year ended January 31, 1910, which compares as follows:

	1910	1909
Gross earnings	$881,177	$839,296
Expenses, 70 per cent	616,824	587,507
Net, 30 per cent	$264,353	$251,789
Interest on investment	294,188	254,038
Net for dividends with city, deficit	*$29,835	*$2,249

*Deficit will be paid to company from net of succeeding years.

DULUTH-SUPERIOR TRACTION.

The Duluth-Superior Traction Company has issued its report for the year ended December 31, 1909, which compares as follows:

	1909	1908
Receipts from transportation	$972,509	$884,213
Other revenue	25,097	8,425
Total revenue	$997,606	$892,638
Operating expenses	559,811	551,780
Net operating revenue	$437,795	$340,858
Interest and taxes	172,366	159,201
Surplus for division and depreciation	$265,429	$181,657
Preferred dividends	60,000	60,000
Common dividends	70,000	.....
Total dividends	$130,000	$ 60,000
Surplus for year	135,429	121,657

After deducting four per cent for dividends on preferred stock there is $205,429, or 5.87 per cent available for the $3,500,000 common stock, as compared with 3.48 per cent earned on same stock last year.

TWIN CITY RAPID TRANSIT.

The report of the Twin City Rapid Transit Company for the month of January compares as follows:

	1910	1909
January gross	$583,963	$525,660
Expenses	302,631	285,825
January net	$281,331	$239,836
Charges, tax and preferred dividends	140,229	133,963
January surplus	$141,102	$105,873

CONNECTICUT RAILWAY AND LIGHTING COMPANY.

At the annual meeting of the stockholders of the Connecticut Railway and Lighting Company, the following directors were elected:

Walton Clark, W. T. Hincks, Lewis Lillie, Randal Morgan, A. W. Paige, H. G. Runkle, Charles C. Sanford, A. O. Shepardson, R. A. C. Smith, M. J. Warner and A. M. Young. The directors elected A. M. Young as president, and the other officers as last year.

The financial statement covering nine months showed gross receipts from the New York, New Haven & Hartford Company under the lease of $877,459. The expenses of the organization were $2,029, and interest on bonds $458,570. Four per cent dividends were paid upon $8,947,200 of common stock, and on $8,142,900 of preferred stock. The construction and equipment account of the company was returned as $31,278,800 and the funded debt as $13,465,700.

The meeting was adjourned until September 7 next, in order to make the fiscal year of the company and its financial returns correspond with the year of the Connecticut State Railroad Commission.

TRI-CITY RAILWAY AND LIGHT.

The Tri-City Railway and Light Company has issued its report for the year ended December 31, 1909. The income account compares as follows:

	1909	1908
Gross	$2,039,488	$1,819,077
Expenses and taxes	1,140,908	1,069,317
Net	$ 898,580	$ 749,760
Interest and sinking fund	522,388	490,294
Surplus	$ 376,192	$ 259,466
Dividends	169,572	166,347
Net surplus	*$206,620	$ 93,119

*Equal to 2.29 per cent earned on $9,000,000 common stock as compared with 1.03 per cent earned on same stock last year.

AMERICAN LIGHT AND TRACTION.

The report of the American Light and Traction Company for the month of March and three months ended March 31, 1910, compares as follows:

	1910	1909
March gross	$275,348	$240,343
Expenses	9,816	8,621
March net	$265,532	$231,722
Three months' gross	966,172	848,032
Expenses	27,602	26,023
Three months' net	$938,570	$822,009

WESTERN TELEPHONE AND TELEGRAPH COMPANY.

The Western Telephone and Telegraph Company has issued its report for the year ended January 31, 1910. The income account compares as follows:

	1909	1908
Interest	$ 624,338	$ 641,447
Dividends	1,544,436	1,578,798
Miscellaneous	868	4,921
Total net receipts	$2,169,612	$2,225,166
Interest and dividends	1,285,741	1,372,250
General expenses	22,430	23,506
Total expenses	$1,308,171	$1,395,756
Net revenue	861,471	829,409
Dividends	800,000	800,000
Surplus	*$61,471	$29,409

*After allowing five per cent dividends on $16,000,000 preferred stock balance $61,471 is equal to 0.38 per cent on $16,000,000 common.

Cleveland Railway.

The Cleveland Railway reports earnings for March as follows: Gross, $475,749; net after expenses and taxes, $127,926; other income, $1,743; total income, $129,669; interest, stock dividend, etc., $110,788; surplus, $18,881. Car-mile earnings were 22.96, surplus 0.91. Car-miles operated, 2,072,141. Under the Taylor ordinance four cents per car-mile is set aside for maintenance and eleven and one-half cents for operating expenses. The company is installing 450 new pay-as-you-enter cars, and financial interests in the city consider the March statement as a proof that the three-cent fare deal is ideal.

Western Electric Business.

According to present indications the predictions of a $61,000,000 year for the Western Electric Company will be fulfilled. With March one-third of the fiscal year was completed and it seems likely that the present year will be the second best since the organization of the company. Its largest year was for the twelve months ending November 30, 1906, when the company did a gross business of $69,000,000.

March returns show an increase of approximately forty per cent over March, 1909, and with one or two exceptions the month was the biggest March the company has experienced. The business of the Western Electric is, to a certain extent, seasonable in character. The spring "peak," or highest point, is attained in the quarter which includes March, April and May, and the fall "peak" in the quarter which includes September, October and November.

To date the fiscal year ending in 1910 has shown a gain of about forty-five per cent over the corresponding period a year ago.

Officers of the company report that the improvement is well distributed between the associated Bell companies and outside operating companies, and that the electric light supplies and machinery branches are coming in for their share of the increased sales. Telephone apparatus and cable sales are about twenty-five per cent ahead of the same period in 1909. The gains are well distributed geographically, indicating a fundamental prosperous condition of the country at large. The Western Electric has eighteen branch houses distributed throughout the United States, and the monthly returns form an excellent barometer of general business conditions.

At the present time the company has approximately 20,000 persons on its payrolls, which is an increase of about 2,000 since the beginning of the current year.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

First Installation of 500-Watt Mazdas.

To the Buckeye Electric Company, Cleveland, O., belongs the credit for making the first commercial installation of 500-watt Mazda lamps. The installation is on the main floor of the new Halle Brothers store in Cleveland and consists of thirty of these new units in opal spheres. The lamps have been entirely satisfactory. They burn at an efficiency of practically one watt per candle and in the first two months of practical service not a lamp has broken or failed.

The Halle store is a twelve-story structure and is equipped with Buckeye Mazda lamps throughout. The *Dry Goods Economist* says, "We are informed by the management that up to the present there has been little or no need of taking merchandise to the door or where it could be examined under daylight, as all colors show up quite satisfactorily under the artificial illumination; especially on the first floor, under the light of the 500-watt lamps, is the satisfactory matching of colors made possible."

The above illustration shows clearly the efficient and practical service which is afforded by the new Mazdas.

500-WATT MAZDA ILLUMINATION.

Fireboat for Duluth & Iron Range Railway Company.

The fireboat, McGonagle, used by the Duluth, Mesaba & Northern Railway Company for the purpose of giving fire protection to its docks at Duluth, Minn., met with such marked success that a similar boat has recently been ordered by the Duluth & Iron Range Railway. With this boat the company's property will be protected in the best possible way against fire.

The practical value of the fireboat is largely dependent on the volume and pressure of the water delivered by its pumping equipment. The greater the pressure the larger the sphere of operations, and the larger the volume the more water poured on the fire per minute.

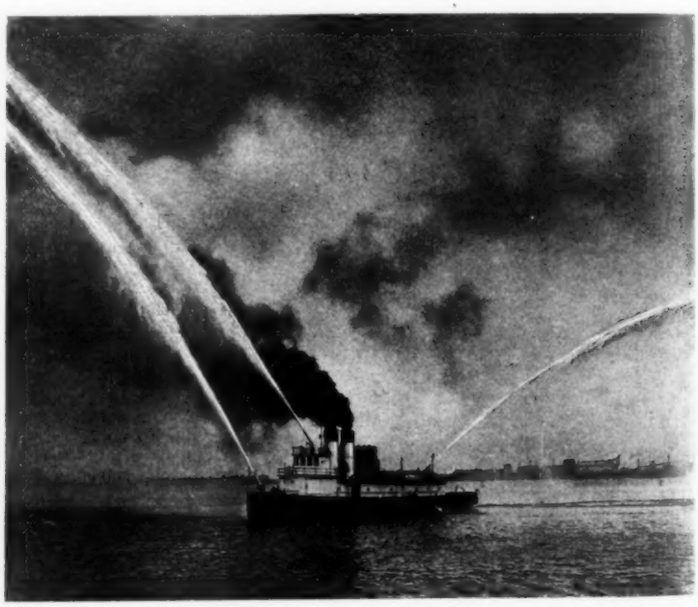
The high steam pressure now demanded in fireboat service can be very economically and safely obtained by the use of centrifugal pumps driven by steam turbines.

The centrifugal pump has the advantage of the absence of valves and other moving parts required in reciprocating pumps, minimizing the cost of maintenance and liability to cause trouble. By using a multistage centrifugal pump or by operating pumps in series, the water can be delivered at a very high pressure. Its use eliminates the strain on the hull due to vibration which attends the use of reciprocating pumps.

High peripheral speed is required to secure the maximum output of the centrifugal pump and consequently the high speed characteristics of the steam turbine, make it an ideal source of power for the pumping equipment of fireboats.

The boat for the Duluth & Iron Range Railway will have the following dimensions: Length overall, 120 feet; beam moulded, twenty-eight feet; depth moulded, fifteen feet. The pumping equipment will consist of two sets of two stage centrifugal pumps, each driven by an 800 horsepower horizontal shaft Curtis steam turbine.

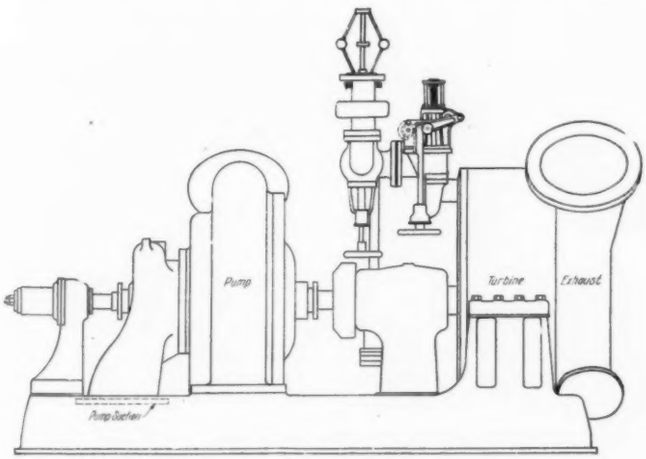
The Curtis steam turbine has many features which especially adapt it to this service. Its high steam economy at all loads, moderate initial cost and low maintenance expense, its ability to use the large amount of available energy below atmospheric pressure make it a very economical prime mover. Its durability and simplicity of construc-



FIREBOAT FOR DULUTH IN ACTION.

tion ensure great reliability of service. The New York, Chicago, Duluth and San Francisco fireboats are equipped with centrifugal pumps driven by Curtis steam turbines and have established a good record as fire fighters.

Each pumping set will deliver 6,000 gallons per minute at a pressure of 150 pounds, and the two operating in parallel will deliver 12,000 gallons per minute at a pressure of 150 pounds. By operating the two sets in series it is possible to deliver 6,000 gallons per minute at a pressure of 300 pounds per square inch. An idea of the immense quantity of water pumped per minute by the two pumps when operating in parallel is gained from the fact that a single truck city car will hold about 6,000 gallons of water and the fireboat would throw an equal quantity on the fire every half minute.



ARRANGEMENT OF TURBINE AND PUMP.

The pumps and turbines will be direct connected and mounted on a common base, the normal speed being 1,800 revolutions per minute.

The turbines will be provided with both automatic and hand controlled governors, and a relief valve will also be supplied to prevent injury in case of a failure to maintain the vacuum.

A ten kilowatt marine generator set of General Electric manufacture will supply current for lighting the boat, and for a powerful searchlight which will be located on top of the pilot house.

The boat will have a speed of about fourteen miles per hour. It will be propelled by a single screw driven by a double vertical high pressure engine having two cylinders, each twenty inches in diameter with twenty-four-inch stroke.

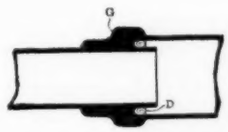
A New System of Lead Jointing.

A new process for the jointing of lead in pipe or other form, the invention of T. Harden, late of the British Insulated and Helsby Cables, Ltd., is being introduced by the Metal Jointing Company, Ltd. (Adelphi House, 71 Strand, London, W. C., England), says *Electrical Engineering.*

The lead surfaces to be joined are cleaned in the usual way and a thin sheet of specially prepared tin is inserted between them. The joint is then heated with a blowlamp, and the melting of the tin causes the lead surfaces on either side of it to melt at a lower temperature than the normal melting point of lead. An actual weld is thus formed between the two surfaces to be joined.

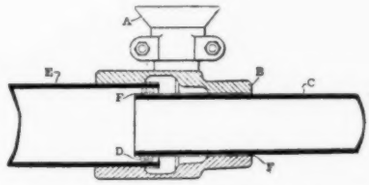
The tin strip for this purpose is supplied by the company under the name of "Amalgaline," and consists of a ribbon of pure tin 0.05 millimetre in thickness, treated with a patent composition to prevent the formation of oxides during heating. In the case of a joint in an ordinary lead-covered cable, after the conductors have been jointed and insulated, the lead sleeve is drawn over the joint, a strip of "Amalgaline" is wrapped round the lead covering of the cable at each end, and the sleeve is dressed down to this. Sufficient heat is then applied to the outside of the sleeve over the "Amalgaline," and the joint is complete.

In telephone, telegraph, and other large dry-core cables, it is not always desirable to dress down the heavy load used for sleeves, and so for such work a mold is used as illustrated in the accompanying figure. The sleeve is passed along the cable in the usual way before the conductors are jointed and the jointing is proceeded with: when completed, the sleeve is scraped clean inside for a short distance, the outer surface of the lead of the cable being similarly treated. A piece of "Amalgaline" is placed on the cleaned part in the interior of the sleeve, and another piece, *F*, is wrapped round the lead sheathing of the cable. The sleeve, *E*, is then drawn into position, and a piece of ordinary engine packing, *D*, is driven between the cable and the sleeve. The mold, *B*, is then placed in



FINISHED END OF SLEEVE.

position and molten lead poured in. An important feature is that the mold is so constructed that the hot metal runs direct from the pouring gate to the space beneath the cable, and then wells up round the cable, so that there is no risk of the lead being burned through by the metal being poured direct on to it. The time for plumbing a large telephone cable is said to be reduced by about thirty minutes.



METHOD OF CASTING END.

The system is also advocated for making tee joints in lead-covered cables, and the company has already supplied a number of small house-service boxes made entirely of lead. These are divided in the usual way, but require no packing. When the joint is complete, "Amalgaline" is placed between the flanges and round the cables where they enter the box, and the whole heated up and welded water-tight. Of course, no supplementary bonding is required.

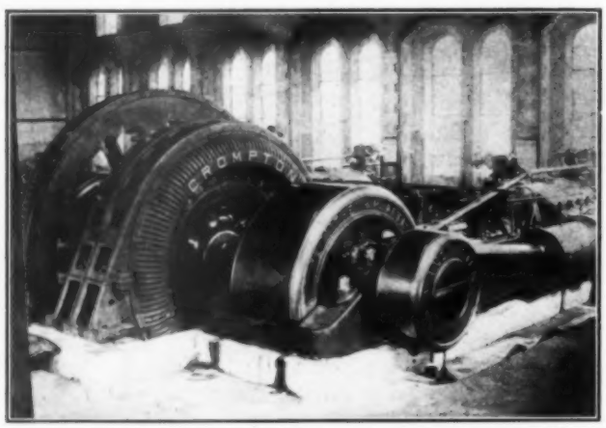
We understand that a large number of sleeve joints have been made by this process by the Fulham (London, Eng.) Electricity Department, and that during a period of over two years they have in no single instance needed the slightest attention.

A Producer-Gas-Driven Alternator Set.

The accompanying illustration is from a recent photograph taken in the plant of Cory Brothers & Company, Ltd., Aber Colliery, Ogmore Vale, South Wales, and shows one of the two sets recently installed there by Crompton & Company, Salisbury House, London Wall, London, E. C., England.

Each set consists of a three-phase alternator of the revolving field type, the rotor of which is mounted direct on the engine shaft. The output of each alternator is 650 kilovolt-amperes at 2,200 volts twenty-five cycles, with a power factor of 0.8. They are capable of giving an overload of twenty-five per cent for two hours, or fifty per cent for half an hour. The alternators are excited off separate plant. The horizontal slow-speed gas engines to which they are attached are driven by producer gas and have a normal rated output of 750 brake horsepower each. The combined sets run at a speed of 107 revolutions a minute.

There are also at this colliery two 270-brake-horsepower three-phase motors which are driven off the above, running at 360 revolutions a minute and driving an endless haulage. These were also installed by Messrs. Crompton at the same time as the above.



THREE-PHASE ALTERNATOR SET AT ABER COLLIERY.

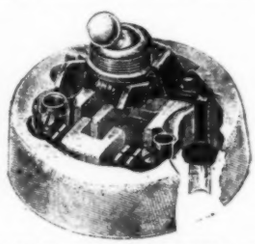
Grounding of Switches.

The desirability of grounding tumbler switches, wherever possible, will undoubtedly appeal to central stations and contractors who realize that a leaky switch, if it does no actual harm, may produce a discontented consumer.

In the accompanying illustration is shown a standard type switch, which by means of a simple alteration in design, may have its switch frame and cover grounded, thereby preventing any possibility of a consumer receiving a shock from the switch when operating it.

Provision is made on the dead metal work to connect a copper strip which runs down into the hole through which the fixing screws pass, ending at the bottom in a conical shaped piece. If the switch is fixed direct onto the conduit box the contact of the screw on to the copper strip and the box will provide sufficient ground. Should the switch be fixed on a wooden block, a wire can be taken through the hole through which the fixing screws pass and held between the screws and the porcelain. The other end must then be suitably connected to the conduit.

These switches are being manufactured and placed on the market by the Wandsworth Electrical Manufacturing Company, Birmingham, Eng.



SWITCH SHOWING GROUNDING ATTACHMENT.

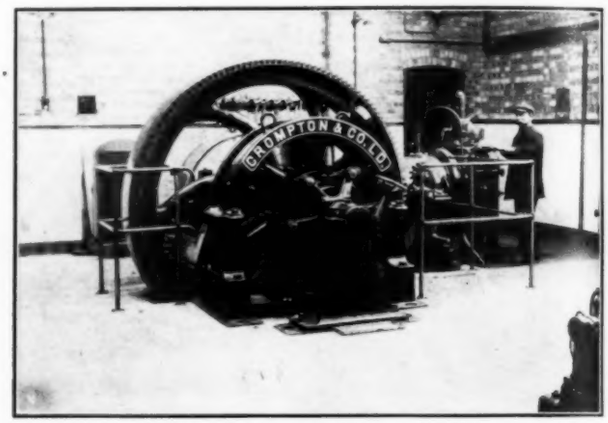
Physics Club in Philadelphia.

A physics club has recently been organized in Philadelphia with Prof. G. A. Hoadley, of Swarthmore College, as president and Dr. Guy W. Chipman as secretary and treasurer. At the fourth meeting held at the Central High School, on March 11, Dr. Paul R. Heyl presented a paper on the magnetic storm of September 25.

An English Gas-Driven Generator Set.

The installation shown in the accompanying illustration is a Crompton standard multipolar open-type dynamo direct-coupled to a Campbell horizontal gas engine. The engine is capable of developing sixty brake horsepower as a working load at 180 revolutions per minute when consuming suction gas, and is fitted with electric ignition capable of adjustment while the engine is at work, so that the point of ignition can be varied to suit the gas being made at any time.

The governor is of the throttle type, and splash lubrication is fitted to all inclosed parts, also self-oiling rings for lubricating other parts.



CROMPTON GAS-DRIVEN GENERATOR SET.

The engine is started by means of compressed air which is stored in a reservoir, and can be charged by means of an electrically driven air compressor.

Cooling water is supplied from large storage tanks over the producer house, the water being raised from a well by means of two small electrically driven centrifugal pumps.

The dynamo is shunt-wound, and is designed to give an output of eighty-five amperes at 480-530 volts.

The machine is mounted on sole plates bolted to the foundations, and is coupled to the engine crankshaft by means of a rigid coupling with bolt connections.

Operating Record for Tunnel Trains.

President McAdoo, of the Hudson & Manhattan Railroad Company states that during March the company carried 4,398,017 passengers. This is the largest number ever carried in any month.

Standards for Ornamental Street Lighting.

Ornamental street lighting is comparatively new but the effects of such systems in cities where they have been installed have been so gratifying that new installations are numerous and progressive cities in all sections of the country are giving the subject much thought.

However, to properly fulfill its function an ornamental street lighting system should provide efficient light as well as being an ornamentation to the street and the design of the standard used, therefore, is an important feature of such a system.

STANDARD FOR ORNAMENTAL STREET LIGHTING.

In this connection attention is called to the standard shown in the accompanying illustration which has been installed in several prominent cities with gratifying results.

This standard, known as the Corinthian design, is manufactured by the Flour City Ornamental Iron Works, Minneapolis, Minn. Its design is simple and effective, following in every respect, the highest form of Grecian art. The column is the simplest form of Corinthian and the four arms are cast with the Greek key.

Another most important requirement of ornamental lighting is a standard which is durable, and which cannot get out of order. The Corinthian standards are cast of a fine grade of iron and each weighs 1,150 pounds. The bases are set on solid concrete blocks, imbedded into which are four steel bolts.

The globes are of hail-proof opalescent glass, frosted on the inside. The wiring is simple and comparatively inexpensive. The manufacturers state that the only repair necessary is a coat of paint about every two years.

An idea of the cost of a lighting system using these standards may be gained from the statistics prepared by the Publicity Club of Minneapolis, in which town there is an extensive installation of this character.

There are eight lighting standards to each block, the standards being about 100 feet apart. Each globe is equipped with a 100-watt tungsten lamp. The actual cost of installation of standards and maintenance for one year, including the electric current, was approximately $2.50 per running foot.

It costs practically $60 per year for maintaining each standard, including electricity, keeping the standards painted and all repairs.

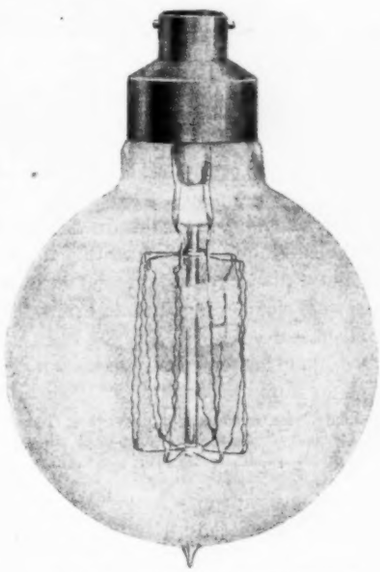
Siemens "Onewatt" Drawn-Filament Tungsten Lamp.

Full particulars are to hand regarding the new "Onewatt" lamps which Siemens Brothers Dynamo Works, of Tyssen street, Dalston, London, N. E., England, are placing upon the market, says the London *Electrician* (April 8, 1910). The "Onewatt" is a tungsten lamp, the filament being of drawn tungsten wire. The efficiency of the new lamps is the same as the average lamp of that type, namely 1.1 watts per candlepower, and owing to the very low rates at which it is being placed upon the market it should find a ready sale. The present "Onewatt" lamps are 100 candlepower for 100-130-volt and 200-250-volt circuits respectively, and are listed at the price of 4s. 6d. (about $1.10) each, subject discounts.

For street and shop lighting they are claimed to be especially suitable, and highly satisfactory results are confidently expected. These lamps are offered to provide municipalities, contractors and consumers with a lamp of very high efficiency at low initial cost, thus reducing maintenance and installation costs which up to now have considerably hampered the adoption of electric lighting in many cases.

A price list recently issued gives full details of these lamps and Messrs. Siemens offer to overprint quantities of these lists with the name and address of any bona fide contractor.

A specimen of the 100-130-volt "Onewatt" lamp which Messrs. Siemens have sent in for our inspection, our contemporary adds, indicates that great care has been taken in its manufacture, and that special attention has been paid to the stability of its construction.



SIEMENS "ONEWATT" TUNGSTEN.

New Electric Car Brake in England.

Consul Augustus E. Ingram reports that the Bradford tramways manager, who is the joint inventor of the extensible axle now in use on the Bradford-Leeds tramway to overcome the sudden change in gage that occurs in that line from 4 feet to 4 feet 8 inches, is about to make the trial in Bradford of a new brake, which he has designed to combine the ideas of the principal tramway managers in England.

A New Type of Ignition for Automobile Motors.

The Kellogg Switchboard and Supply Company is manufacturing and placing on the market a new type of ignition, the "Delco," that is proving very popular. It is designed particularly to give long life to the batteries, do away with timer trouble, make adjustment unnecessary and give ease of starting.

FIG. 1.—"DELCO" DASH UNIT.

A few systems now sold are designed to give but one spark; but they make the motor harder to start and require adjustment of contact points every few hundred miles.

Ordinary battery ignition is not favored by some because of the constant adjustment necessary to keep it in order, also because of the frequent timer trouble and because of the very large battery consumption.

On the other hand, every motorist knows that battery ignition has certain marked advantages over every other form of ignition. The car can be started more easily, can be driven more slowly in a crowd and a much greater range of advance can be secured than is possible with any magneto.

Fig. 1 shows the "Delco" dash unit, in which the coil, controlling relay and switch are mounted in a highly finished mahogany box. This unit is very compact and is attached to the front of the dash board. If preferred the coil box and relay are furnished for installation under the seat or hood with nothing but the switch on the dash. The dash unit contains four induction coils, without vibrators, one for each motor cylinder. The induction coils are imbedded in a special heat resisting insulating compound protecting them from dirt, oil or dampness.

The high-tension terminals at the bottom of the box (Fig. 2) are of special design with genuine hard-rubber insulation.

In these terminals, which are entirely new, the wire is inserted through the hole in the terminal lug and brought around and under the screw. It cannot work loose and a perfect connection at all times is ensured.

The controlling relay takes the place of the four vibrators on an ordinary coil unit. It is for the purpose of breaking the primary circuit and thereby producing a spark from the secondary windings of the induction coils. It differs from the ordinary vibrator, however, in that it uses but one spark for each contact of the commutator. It is very simple and does not require adjusting. It will operate for 10,000 miles without the slightest attention.

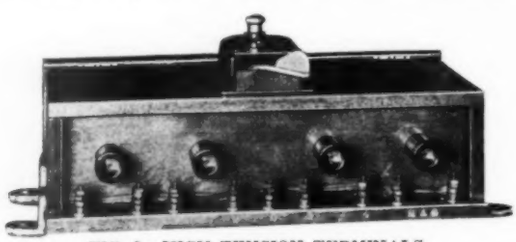


FIG. 2.—HIGH-TENSION TERMINALS.

The switch (Fig. 3) on the "Delco," it is claimed, is proving the best and most reliable ever placed on automobiles. It requires no attention under normal conditions. It is so secured to the box that it cannot be tampered with or removed. Each switch is furnished with a key and can be locked, preventing theft.

FIG. 3.—SWITCH.

Telephone Construction in the South.

To show the interest that many southern farmers are taking in the extension of telephone lines throughout the country districts of the south, an interesting fact has been developed by the publication recently of statistics showing the financial help given by these farmers. It is an interesting fact that in a great many progressive towns in the south, the merchants and business men realizing how the establishment of such means of communication with the rural sections will stimulate and develop trade are making every effort to have farm telephone lines built into their towns. Carefully collected statistics show that in places the merchants have voluntarily made contributions varying in amounts from $25 to $500 to aid and encourage farmers to build telephone lines and connect with the nearby towns. The merchants, doubtless, are amply rewarded by the increased trade. B.

Telephones on the Atchison.

The Atchison has extended its telephone dispatching from Denver to Pueblo, making a total of 2,000 miles so equipped.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, APRIL 8.—A paper was read before the Institution of Electrical Engineers in London last night, in which were set out some remarkable results, which have been achieved in connection with electric brakes on the Glasgow tramcars. All the Glasgow cars are fitted with the Westinghouse (Newell) electric brake, but the Glasgow corporation tramway department and the British Westinghouse Company have been carrying out experiments which have greatly improved the efficiency. With the object of preventing skidding, solenoid controlled fields were used, viz., a shunt is introduced automatically, as required, by means of a solenoid operated switch. Exhaustive tests showed that the coil operating the solenoid should be in series with the main brake circuit, this giving the more reliable and rapid action. This, in conjunction with more powerful magnets, in which the poles are placed side by side, and parallel to each other, marks a most important advance in electric braking, for not only does it give a far greater maximum pull, but the effect with a current of five amperes is greater than that of the old magnet with fifty amperes. The difference in the heating of the motor is most important.

Some important Parliamentary Committee decisions concerning London tube railways have been given this week. There are at present operating in London three tube railway companies—the Yerkes group—each with separate boards of directors and separate organizations generally. Parliamentary sanction has now been given for these three lines to be amalgamated, and for the three classes of stock to be consolidated. The main cause for this amalgamation rests upon the enormous growth, during the past two years, of through or exchange traffic between these lines. Indeed, the companies themselves look to this as being the main development of their undertakings in the future. Obviously, therefore, an amalgamation is in the best interests of everybody.

Another decision of interest, perhaps, rather than importance, deals with an effort on the part of the underground railway companies to deal with their passengers—as between the deep level stations and the streets—more expeditiously. It is now proposed, and it has been sanctioned, to construct a sloping subway at the Oxford Circus station at a depth of fifty-two feet at the station and a few feet at the street level, in which will be run moving stairways or escalators. At the present time it seems practically impossible for the lifts to keep time with the trains and the result is that numbers of passengers complain of the delay in getting to the surface. It is hoped to remedy this by the new proposal.

There seems some possibility of a revival in relation to the use of windmills for generating electricity. A forty-eight-foot wheel is about to be erected in Somersetshire on a farm where there will be over 300 lamps. It is an interesting fact that no less than eighteen years ago a considerable number of American windmills were erected in this country and among them was a large wheel on the roof of a London miller's premises which was the first to be used for electric lighting in conjunction with a storage battery. It was eventually removed by an order of the London County Council under the Sky Signs Act. The premises in question were about one hundred feet high and the wheel stood on a fifty-foot tower. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, APRIL 6.—A hydraulic plant has been recently erected on the Murz River at the locality of the Murzzuschlag and near the railroad which passes from this point to the town of Neuberg. Low pressure turbines are employed here, as the fall is about twenty feet. There are installed in the plant a number of three-phase alternator units and a bank of transformers which deliver 5,000-volt current to the power line. A steam engine unit has also been erected in the station as a standby.

Among the new companies formed at Paris, I note the General Wiring Company, for the construction of light and power lines, also the firm of Stigler et Cie, which is engaged in the manufacture of alternating current rectifiers on the Stigler-Faria system. At Villefranche there has been formed the firm of Pagnon and Brouard for electric supplies, and at Grenoble, Picard and Sauret, for various kinds of electric apparatus. The Rhone Valley Electric Company of Teil, is formed for the purpose of operating power distribution lines in this region. Roth and Seltensperger, of Belfort, are engaged in electric lighting work.

The cities of Bale, Switzerland, and Belfort, France, will soon be connected by an electric railroad line, and the new road has the peculiarity of lying in three countries—France, Germany and Switzerland. When completed the line will comprise a section running from Belfort to Rechesy, via French territory, and this portion will be one of the first to be built. There already exists a line from Bale to Flüben and this has now been extended as far as Rodersdorf and is soon to be run from thence to Ferrette. From this point a section of only eight miles length making connection with Bonfol is all that remains to complete the electric road.

Karlsbad, Austria, is to have an electric tramway line installed in the near future, and the plans for the project also call for two electric cable inclines. It is expected to carry out the enterprise by 1911. In Italy the prefecture of Reggio Emilia has granted the rights to the Novara electric plant for an extension of its power lines from the locality of Guastalla as far as Novellara, for electric lighting purposes. The towns of Mondragone and Cervara are soon to have an electric lighting supply. The municipality of Mantova granted the rights to the Bresciana Electric Company for installing a set of mains which are needed for operating the electric tramways in that locality. In France, the company which controls the electric tramway system of Menton, in the Riviera, is soon to carry out a project for running elctric trains between Menton and Villa Caseria.

At the Brussels Exposition there is to be held an international congress of radiology and kindred electric applications. The congress will be divided into three sections: 1. General questions, terminology and methods of measurement as applied to radioactivity; 2. Study of fundamental theories of radiology and electricity; 3. Biological work. Communications can be addressed to the secretary, J. Daniel, L rue de la Prevote, Brussels.

An electric tramway system is being talked of for Beyrouth, Turkey, and it will be among the first to be installed in that country. The rights for an elctric tramway in the town of Broussa have been granted to Dr. Yovanovitch, of Smyrna. A. DE C.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, ONT., APRIL 16.—For some time past the report has been current that the Michigan Central proposed to electrify the branch between Niagara Falls, Ont., and old Niagara. The Niagara Falls boad of trade has asked the railway authorities to proceed at once with the electrification of the road.

The St. Lawrence Power Transmission Company's bill has passed its final stage in the Canadian Commons and will now go to the Senate. The bill has been so much amended and modified as to be scarcely recognizable as the one originally introduced. It has centered public attention in the designs of certain American financiers to acquire control of such Canadian water powers as lie within easy transmission distance of industrial districts.

The Ottawa & Montreal Power Transmission Company's bill, proposing a power line from Mattawa to Montreal, has ben shelved for the present session of parliament, in consequence of a technicality in regard to the length of time notice is required to be given, respcting such measures, in Ontario. A portion of the transmission line is to run through this province. The company is composed of Ottawa capitalists who own four water powers on the Ottawa River.

Canadian telegraph companies announce the inauguration of a "night lettergram service" whereby letters may be sent by wire for delivery the following morning, at a cost far below the night rate previously in force. Under the new schedule, a letter of fifty words, or less, may be sent to any part of Canada or the United States, at the rate usually charged for a ten-word day message. Where the minimum rate is twenty-five cents for a day message, a letter of fifty words will be transmitted at night for the same price. No code or cipher will be allowed to come under the new rate. The Canadian Pacific and the Great North Western telegraph companies are those moving in the matter.

By the first of June next, power developed by the Hydroelectric Commission of Ontario, will be available in the city of Toronto. The McGuigan Construction Company has been busy all winter, and has erected towers for carrying the electric energy to a point within a few miles of the city limits. This gap will shortly be filled, and there will then be a second line of steel towers extending all the way from Toronto to Niagara Falls. A matter that seems now to be troubling the electric commission is whether the city will be ready to take the power as soon as the commission is prepared to deliver it.

After mature consideration of the matter, the Dominion government has reached the definite decision not to disallow the hydroelectric legislation of the Ontario government passed last year. Application for disallowance was made last summer by a number of companies interested in electrical development in the Niagara district, and the matter has been under consideration of the federal

government since that time. Those who were opposed to the local government's act, took the ground that it constituted an unfair and unconditional infringement of vested rights, involving millions of dollars; and that Canada would be seriously injured as a field of investment for foreign capital, if provincial governments were permitted to supplant industries of this kind in which so much has been invested. The minister of justice for Canada, in recommending to his colleagues that the legislation of the Ontario government should not be disallowed pointed out that whatever might be the opinion of the federal authorities as to the wisdom or unwisdom of such legislation, the matter was one that affected the province only, and which its electorate should be allowed to decide for itself. Further, no valid reason has been advanced that the credit of the Dominion as a field for foreign investment had been affected. Hundreds of thousands of dollars' worth of bonds of the private companies, now established in the Niagara district, are held by American financial institutions. It may be added that the legislation in question authorizes the hydroelectric commission to construct and operate power transmission lines from Niagara, and sell power to Toronto, Hamilton, London and other districts within a radius of 150 miles from Niagara. W.

MEXICO.

(Special Correspondence.)

MEXICO CITY, MEXICO, APRIL 18.—It is announced that the plans of the El Tigre Mining Company not only provide for the erection of a large hydroelectric plant on the Bauispe River, in the state of Sonora, but also include the construction of an electric railway to run between the mines and reduction works of the company in the El Tigre district and Douglas, Ariz. It is stated that the high grade ores of a number of big producing mines in this district will be carried by this line to the smelter. The line would be about seventy-five miles long. The site of the proposed hydroelectric plant has not yet been definitely decided upon. The company has been endeavoring to secure a railroad outlet for its ores for some time. It was recently reported that the Southern Pacific would extend its line to El Tigre; also that the El Paso & Southwestern was considering the matter of building an extension of its line from Douglas to this place, but no confirmation of these reports has been obtained.

A number of local capitalists of Merida, Mex., are arranging to build an electric railway to run between Merida and the ruins of Uxmal. The ruins are visited by many tourists and the trip is now a difficult and tiresome one.

George Pinson and associates will erect a large hydroelectric plant in the State of Michoacan. The water of the Zitacuaro River will be used to operate the plant. Transmission lines will be constructed to Morelia and a number of other towns and industrial centers. Mr. Pinson has made application to the federal government for a concession for the proposed enterprise. D.

LIGHTING AND POWER.

(Special Correspondence.)

MONTESANO, WASH.—The plant of the Montesano Light and Water Company was recently sold to Seattle interests.

TYNDALL, S. D.—The city council is planning installing a municipal electric light system at a cost of about $20,000.

MUSKEGON, MICH.—The proposition to issue $75,000 bonds for a municipal lighting plant recently carried by a large majority.

MONTGOMERY, MINN.—S. A. Vopatek, of New Prague, and A. P. Washa have asked for a franchise to install an electric light plant. C.

GAINESVILLE, GA.—This city has voted $5,000 bonds for the extension of its electric light system. Address the mayor for information. B.

REDDING, CAL.—The Sacramento Valley Power Company has turned on current to Red Bluff. Red Bluff will herafter be lighted by this company.

SPRING VALLEY, MINN.—W. J. Pulford, of Sioux Rapids, Ia., is considering the purchase of the electric lighting plant and the installation of a new system.

CANAL DOVER, O.—The city has sold $15,000 additional bonds for its electric light plant, the amount previously sold not being sufficient to complete the work.

HATFIELD, WIS.—The La Crosse Water Power Company, of La Crosse, Wis., is taking bids for the construction of a dam, 350 feet long and thirty-three feet high. C.

MORTON, MINN.—The council granted a five-year franchise to the Wherland Electric Light Company, of Redwood Falls, Minn., for the installation of an electric light plant. C.

HACKENSACK, N. J.—As a result of a recent meeting of the commission, arc lights will be installed along Main street, making this street into a second "Great White Way."

CRIVITZ, WIS.—L. E. Myers Company secured the contract for the erection of a transformer building at High Falls, to cost $50,000, and work has been started on the foundation. C.

MANKATO, MINN.—The Consumers Power Company has purchased the Mankato Gas and Electric Light Company and will make extensive improvements and enlargements in the plant. C.

EAU CLAIRE, WIS.—Men interested in the Chippewa Valley Railway, Light and Power Company, of Eau Claire, have bought the entire capital stock of the Chippewa Falls Water Works and Lighting Company. C.

ROME, GA.—The Rome Railway and Light Company will spend about $35,000 for improvements and is inviting bids for equipment, including a 1,000 horsepower turbine to be installed in the power house. B.

ELKTON, MD.—The new plant of the Home Manufacturing Company is now supplying current for motors and blowers used in the plant of the J. F. Powers Company. The plant will later be entirely motor-driven.

FLORENCE, S. C.—The Florence Light and Power Company has been sold at auction for $72,000 to Martin Maloney of Philadelphia. It is estimated that the value of the property is considerably in excess of that figure.

BOLEY, OKLA.—The Boley Light and Power Company has been organized here with a capital stock of $5,000 for the purpose of installing an electric light and power plant. D. J. Turner of Boley is one of the incorporators. D.

SILVER CITY, N. M.—The Black Range Reduction Works has adopted plans for the erection of a hydroelectric plant on the Gila River, near its mines. The proposed plant will afford power for operating machinery of the company's property. D.

ALLENTOWN, PA.—An ordinance has been passed awarding the contract for lighting the streets of Allentown to the Allentown Electric Light and Power Company, for a period of ten years at $64 for each arc lamp and $19.25 for incandescents.

MONTGOMERY, ALA.—The Columbus (Ga.) Power Company, which has Alabama headquarters at Phenix City, has qualified in the state, and will use $200,000 in business in Alabama. Warren Williams, at Phenix City, is the Alabama representative.

CARTERSVILLE, GA.—The city council has appointed a committee to receive bids from engineers, to make plans, estimates and recommendations for the extension of the city's electric light plant with a view of installation of day current. Paul Gilreath is mayor. B.

GUTHRIE, KY.—The Guthrie electric light plant has been sold to W. O. Nelson and E. L. Buckley, owners of the Guthrie Milling Company. They will move the plant from its present location to the mill property and run a day current and operate the mill by electricity.

LAKE CHARLES, LA.—The Kinder Ice, Light and Water Company has been organized for the purpose of erecting an electric light and power plant and other public utilities at Kinder, La. Paul O. Moss, of Lake Charles, is president. The company has a capital stock of $25,000. D.

EL TIGRE, STATE OF SONORA, MEXICO.—The El Tigre Mining Company will install an electric power plant here for the purpose of furnishing power for operating the machinery of its mines and mill. It is reported that the Southern Pacific Railroad will build a branch line to El Tigre. D.

SALT LAKE CITY, U.—The Jennie mine and mill at Gold Springs will by May 1 be in operation provided by the Modena plant of the Gold Springs Mining and Power Company. Installing the machinery of the power plant, which is to generate electricity with gas-producer engines, has already been completed.

MANCHESTER, N. H.—The new powerhouse on the Merrimack River was recently put in operation and is now supplying power to the Coolidge Mill. Power is at present supplied by a 3,500-kilowatt generator. A second machine, to be installed later, will deliver power to the Jefferson, Amory and Langdon mills.

SHAMOKIN, PA.—The plant of the Shamokin Light, Heat & Power Company was sold recently for the sum of $750,000. Some time ago, realizing the value of the plant, New York parties paid $5,000 for an option. The new company contemplates a number of changes in the lighting system and will erect a new gas plant during the coming summer or in the early fall.

BLACK RIVER FALLS, WIS.—The La Crosse Water Power Company will soon let the contract for the erection of its new dam on the east fork of Black River. The dam will form a lake about four miles wide and fifteen miles long. It is stated that the company intends to build a dike from the dam back to the highland, a distance of 4,000 feet, to further protect the structure. M.

CHARLOTTE, MICH.—At a recent chancery sale, Circuit Court Commissioner J. C. Nichols sold the Charlotte General Electric property to M. W. Eaton of New York and W. A. Foot of Jackson for $30,000. The Commonwealth interests have been in charge of the plant for some time. This property is included in the big electric and power merger.

ALAMOS, STATE OF SONORA, MEXICO.—It is reported that the plans for the hydroelectric plant that the Mayo River Power and Land Company will erect on the Mayo River at San Bernardo, Alamos district, have been approved by the officers of that company and the order has been given for the construction work to be started. The principal offices of the company are in Denver, Col. D.

EVANSVILLE, IND.—Increase of business has necessitated the

installation of additional steam turbines and boilers at the electric light station, Elsas Avenue and Division street. Contracts for the steam turbines with capacity of 2,000 to 2,500 kilowatt have been awarded. Manager Blynn of the Evansville Gas and Electric Light Company estimates that the cost of the new materials will be about $25,000.

SALT LAKE CITY, U.—The Salt Lake Electric Supply Company has obtained the contract for the lighting fixtures of the new Commercial club building, the figure being $8,000. It is one of the largest single lighting contracts ever let in the state. The lighting of the building is to be of the most elaborate character, the designs of the various rooms conforming with the different styles of architecture.

COLUMBUS, GA.—The Columbus Power Company, holding large interests on the Chattahoochee River, has filed incorporation papers at Montgomery, Ala., the capitalization being $1,800,000, of which amount $800,000 is said to be invested in Alabama. The Stone-Webster syndicate of Boston is at the head of the concern, and the incorporators are John L. Flournoy, L. F. Garrard, and associates. L.

NORTH ADAMS, MASS.—The Light, Heat and Power Corporation of Boston is increasing the power capacity of its North Adams plant and has just placed an order with Allis-Chalmers Company for a turbine. During last summer the company installed two 500-kilowatt turbines of the same make. The new turbine is a 1,000-kilowatt, 2,300-volt, sixty-cycle, three-phase condensing machine.

SANTA RITA. N. M.—The Chino Copper Company has filed an application in the office of the territorial engineer at Santa Fe for the use of the water from Apache Tejo spring, near Santa Rita, Grant County, for the operation of a hydroelectric plant that it will erect. It is stated that the proposed plant will cost about $250,000. It will furnish power for operating the machinery of its mines and reduction plant. D.

AMERICAN FORK, UTAH.—John H. Wooten, manager of the Utah County Light and Power Company, states that his company may decide to furnish light for Eureka. The company has already asked the city council to grant a franchise which will enable the disposal of power and light to the various residents. The company built into Tintic last year for the purpose of supply lights to the Knight smelter.

ATLANTA, GA.—Secretary Phil Cook has granted a charter to the Athens Railway and Electric Company, whose capital is $1,050,000, to build an electric plant and operate an electric street railway system in Athens. The company also asks the right to issue $300,000 preferred stock. John R. White, Whitehall, Ga.; W. S. Holman, J. M. Hodgson, and others of Athens are the applicants for the charter. L.

OGDEN, U.—Announcement has been made of orders for preliminary surveys for a 180-mile power line from Shoshone Falls, Idaho, into Oregon, being undertaken by a large power plant company recently organized by eastern capitalists. The idea behind the big project is to furnish more power for the proposed interurban electric lines centering around Ogden. David Eccles and other Utah men are said to be interested in the enterprise.

BALTIMORE, MD.—A heating plant close to the Pennsylvania railroad and near the new city hospital at Bayview has been agreed upon by sub-committees representing the hospital commission and the other the Supervisors of City Charities. By the change the heating plant will supply heat and current to the almshouse, the hospital and Sydenham Hospital for Contagious Diseases. A saving in hauling of forty cents a ton will be effected by having the plant close to the railroad tracks.

NIAGARA FALLS, N. Y.—Articles of incorporation have been granted the Hydraulic Power Company of Niagara Falls. The company will develop and utilize the power of the hydraulic canal and will sell such power. The capital stock is $500,000 and the directors are George B. Matthews, William D. Olstead, Jacob B. Schoellkopf, Arthur Schoellkopf, Paul A. Schoellkopf, Jacob Schoellkopf, Jr., of Buffalo, Morris Cohn, Jr., Niagara Falls, Hans Schmidt, of Buffalo, and Henry Van Berge, of Buffalo.

MARSHALLTOWN, IA.—Jones and Hovey of Independence, Ia., owners of the Marshalltown Light, Power and Railway Company, have offered to sell to the city its electric lighting, heat and power plant for $325,000, exclusive of the street railway lines. The offer has been made through Mayor O. L. Ingledue, but there is small chance of its being accepted as it is generally conceded that the price is from $50,000 to $100,000 higher than the plant is worth. Mayor Ingledue is in favor of the purchase.

AUSTIN, TEXAS.—It is announced by J. C. Dumont who is at the head of the company that recently entered into a contract with the city of Austin to reconstruct the dam across the Colorado River and install a hydroelectric plant at a total cost of $1,000,000 that machinery and material for the work has been ordered and that construction operations will be started about June 1. The remaining parts of the old dam will be strengthened and used. The new portion will be built of reinforced concrete. D.

KINDER, LA.—Charter was recently filed of the Kinder Ice, Light and Waterworks Company. The capital stock of the company is to be $25,000, divided into 250 shares of $100 each. The officers of the company are Paul O. Moss, president; John R. Lyles, vice-president; H. A. Keys, secretary-treasurer. These, with C. F. Howell and Turner T. Nixon, make up the board of directors. The company expects to be able to be in operation within a very short time, as the work of erecting buildings and getting equipment for the plant is already under way.

PORTSMOUTH, R. I.—The Portsmouth Electric Light and Power Company has taken out a charter with capital of $100,000. The president is Henry C. Anthony of this town, and John L. Borden of Portsmouth and George R. Lawton of Tiverton are interested; David J. White of Providence is the secretary. The company has applied for rights in Tiverton and it seems probable that at some time in the future the companies in the two towns may in some measure be united. It is not probable that active steps will be taken this season in Portsmouth.

DEFIANCE, OHIO.—A franchise has been granted to the Valley Power Company, which proposes to utilize the water power of the Auglaize River in this city. The company will furnish power for manufacturing plants, and will make a very attractive proposition to light the city. It proposes to give the city free arches throughout the business section. It is possible that the idea of erecting a municipal plant may be abandoned, and the proposition of the new company accepted. Congressman T. T. Ansberry, H. D. Bokop, and H. W. Steinberger are the leading promoters of the project. H.

ROCK HILL, S. C.—A peculiar situation has arisen here, where the local electric lighting company has received not a cent in twenty months for lighting the town, it being claimed that the town ordered the lights cut off at that time because no contract had been agreed upon, but the company continued the service. Several meetings have been held recently looking to a settlement of this extraordinary state of affairs but nothing has resulted. The city council has, therefore, directed the public works commissioners to proceed with the building or acquirement of a lighting plant. The town voted $35,000 some time ago for a municipal electric lighting plant. L.

HOUSTON, TEXAS.—The new electric power plant that is being installed by the Texas state university at Austin is looked upon as such a model for the purpose intended, that its plans have been adopted for the power plant that is to be erected for the proposed Rice Institute at Houston. The construction of the buildings that are to comprise this great educational institution will be carried on rapidly, it is announced, and the power plant will be in readiness by the time the other buildings are finished. Dr. Edgar Odell Lovett who is at the head of the Rice Institute recently visited the state university power plant at Austin and was highly pleased with its completeness. D.

PHOENIX CITY, ALA.—The Columbus Power Company, Columbus, Ga., with J. S. Bleecker, manager, has been incorporated in Alabama with Phoenix City as its headquarters in that state. The Alabama agent is Warren Williams, Phenix City, Ala. This company is building a short railroad line through the county to Goat Rock on Chattahoochee River where it is to build dam and power house, in addition to the three existing plants at Columbus. Transmission lines will be built from site of new dam to such Alabama cities as may be in the market for electricity. The capital stock given in the Alabama corporation is $1,800,000, and the company will invest $200,000 in Alabama at this time. B.

GUNNISON, UTAH.—The Gunnison Valley Power Company has been incorporated with a capital of $50,000 to furnish light, heat and power to the towns in Sanpete County. The directors are: M. Beauregard, president; S. M. Duggins, vice president, treasurer and manager; Lorenzo Edwards, James Bown, L. W. Roush, secretary and engineer. The plant is located on Six-mile Creek, and will be the best medium sized power plant in the State of Utah. A sufficient amount of water and fall is obtained to develop 400 horsepower with minimum flow of the stream. It is the present intention of the company to furnish light and power to the towns of Gunnison, Centerfield, Mayfield, Sterling, Axtel and the vicinity.

GRAHAM, N. C.—The Hydraulic Properties Company has been awarded the contract for the engineering of the entire proposition which includes the reinforced hollow concrete dam of the Ransom type, power house, a reinforced concrete highway bridge, and the installation of three 600 kilowatt alternators, sixty cycle, three phase, connected direct to three 900 horsepower wheels. Transmission lines will be extended to Graham and Burlington, and engineering work done for a 10,000 spindle cotton mill which will be equipped to spin 20's to 26's yarns and will be supplied with 240 forty-inch looms. All of the above work is in charge of the Hydraulic Properties Company, and is for the Falls River Cotton Mills Company, of which J. W. Menefee of Graham, N. C., is president and treasurer.

OROVILLE, CAL.—Following the acceptance of the bids of Hanscom & Kimball, of Paradise, for a franchise to operate an electric power line over all public roads in Butte County, Mr. Hanscom, of the firm, announced that his company will erect a power system to supply the settlements along the Paradise Ridge with light and power. The company has recently located sufficient water on Chico Creek to generate 2,000 horsepower and plans to start the pole and wire work at once. The towns of Paradise, Orloff and Magalia will be supplied by the company.

TAFT, CAL.—The Moran Electric Company has been incorporated by J. B. Murdock, J. W. Ragsdale, C. C. Painter, R. E. Woods, H. E. Smith, J. A. Felter and A. A. McCumber, with a capital stock of $75,000. The object of the company is to furnish light, heat and power for the town of Taft. The plant will be in operation about the first of June. A.

KINGSPORT, TENN.—The Equitable Securities Company, which awarded a contract for crushing and cement machinery for its new plant to Allis-Chalmers Company a short time ago, has now given the same company the contract for the necessary motors to drive the apparatus. There will be twenty-nine squirrel cage induction motors and three wound-rotor induction motors. The sizes vary from twenty-horsepower to 150-horsepower. Six 100-kilovolt-ampere oil-filled self-cooled transformers are also included in the order.

RICHMOND, VA.—Contracts made by the committee on electricity at a meeting held March 14 for wiring, conduits and other work in connection with the municipal electric plant have been approved by Mayor Richardson. The main contract goes to the McCay Engineering Company, of Baltimore, for eleven iron lamp posts, conduits and manholes. The work is to be completed within the next four months and is to cost $10,700. An allowance of $3,700 is made for additional ducts and other work. The contract for all underground cables, service and transformer cable connections, to be laid according to plans ready for service, go to the Safety Insulated Wire and Cable Company. The chairman of the committee is authorized to enter at once into written contracts for the work.

SARTELL, MINN.—The Watab Pulp and Paper Company has practically completed additions to its plant here which give it twice the capacity of the original installation. Allis-Chalmers Company, which furnished the power equipment for the first installation has recured the contract for the rest of the eletrical machenery, as follows:—A 560-kilowatt, three-phase, sixty-cycle, 440-volt waterwheel generator, a 300-kilowatt synchronous motor generator set, a 300 horsepower, 240-volt variable speed direct current motor, one 150-horsepower, one 100-horsepower, one fifty-horsepower and one forty-horsepower wound rotor induction motors, two forty-horsepower, two thirty-horsepower and one seven and one half-horsepower squirrel cage induction motors, one thirty-five-horsepower and one seven and one-half-horsepower direct current variable speed motors.

ELECTRIC RAILWAYS.

(Special Correspondence.)

HIBBING, MINN.—W. M. Brown and others are planning the construction of a street car line to the village of Alice, estimated to cost $40,000. C.

CHARLES CITY, IOWA.—C. C. Hart, Charles City, is promoting the construction of an electric line to Webster City, passing through Dows City to Hampton. C.

LOS ANGELES, CAL.—A franchise has been asked at Riverside for a trolley line from Riverside to Hemet and San Jacinto, a distance of twenty-five miles.

ALBUQUERQUE, N. M.—Construction has been started by the citizens Traction and Power Company, on the new Highland car line. The work will be completed in three months. A.

EVERETT, WASH.—The Washington Railroad and Electric Company is planning the construction of a railroad seventeen miles long, to run from Sultan Canyon to the town of Sultan. A.

NEW DECATUR, ALA.—The construction of an electric road from New Decatur to Russleville, Ala., a distance of fifty miles, is being agitated by W. J. Cottingham, New Decatur, and others. B.

YANKTON, S. D.—The Iowa & Dakota Interurban Railway Company, capital $500,000, has been incorporated to construct an electric road from Mitchell, S. D., to Sioux City, Iowa, a distance of 125 miles. C.

PORTLAND, ORE.—Manager F. I. Fuller of the Portland Railway, Light and Power Company has decided to lay a double track on Sandy road from east 16th to east 28th streets to be connected with the Burnside street bridge.

STOCKTON, CAL.—The Stockton Terminal & Eastern Railroad has been incorporated by A. Shane of Indianapolis, W. H. Newell of Stockton, A. A. Grant of Sonora, M. J. Congdon, J. E. Adams and R. V. Dixon of Berkeley. A.

BAKERSFIELD, CAL.—The Power Transit and Light Company has been granted a franchise for an electric street railway on Twenty-third Street from Chester Avenue to M Street and on M Street from Twenty-third to Twenty-eighth streets.

FORT WORTH, TEXAS.—The Northern Texas Traction Company has adopted plans for car shops which it will construct here. It is announced that it will build its own cars and do all kinds of repairing. The new building will be built of brick and concrete materials. D.

LAFAYETTE, IND.—The electrical machinery and other equipment on the Huntington power house of the Ft. Wayne and Wabash Traction Company has been removed to this city and is being installed in the new power house of the company. The power house at Huntington was built and equipped as a result of a bonus paid by the citizens and the dismantling has been stoutly opposed. S.

GREENVILLE, S. C.—Surveying parties have completed the location of interurban trolley lines in South Carolina, between the manufacturing towns of Greenville, Piedmont, Pelzer and Anderson, also between Greenville, Spartansburg and Anderson. The lines are part of the projects being developed by interests identified with the Southern Power Company.

FAYETTEVILLE, N. C.—Commissioners N. A. Sinclair and C. W. Broadfoot have sold at public auction the property of the Fayetteville Consolidated Street Railway and Power Company to Mrs. M. B. McRae, of Fayetteville, for $67,000. The deal includes a hydroelectric plant, right-of-ways, franchises, system, etc., and the sale is made under a decree of the superior court. L.

WAUSAU, WIS.—The Wausau Street Railway Company has purchased at Mosinee flowage rights sufficient for the development of a twenty-one foot head at its dam. The creation of a head of this height would give 6,000 actual horsepower from the generator. The development of the dam will take place as soon as a call for sufficient power is created to insure the expense of the work.

ELKHART, IND.—H. E. Buckner of Chicago, owner of the St. Joseph Valley Traction Company announces that he has arranged with the South Shore line for an extension of the line from South Bend to Elkhart to connect with the Bucklen line which extends from Elkhart to Angolia. When this is done Mr. Bucklen says he will extend his line from Angolia to Pioneer, Ohio, and connect with an electric line into Toledo, O. S.

WASHINGTON, IND.—The Burnes Traction and Construction Company of Chicago has purchased the Washington Street Railway system and will operate in in conjunction with an interurban road the purchasers propose building from Indianapolis to Evansville. The Burns Company has made extensive surveys and propose entering on the construction work in a short time. The Washington plant will be greatly improved and some new machinery is soon to be added. S.

BEECH GROVE, IND.—The Beech Grove Traction Company has elected the following: President, W. H. Ogan; vice-president, John Woeher; secretary, Fred C. Schmidt; treasurer, Morton S. Hawkins; directors, W. H. Ogan, John Woeher, C. F. Schmidt, M. S. Hawkins and William Garnstang. The directors passed a resolution increasing the capital stock to $100,000 and $50,000 of preferred stock has been issued. The Security Trust Company is financing the work of building an interurban road from Beech Grove to Indianapolis.

SOUTH BEND, IND.—The first through electric car from Louisville to South Bend has been run, the 296 miles being covered in less than eleven hours. As South Bend has trolley connection with Chicago, Louisville-Chicago service is now probable within the near future. The 117 miles from Louisville to Indianapolis was made in four hours. The fastest time was on the Winona tracks, where three miles were covered in three minutes and twenty-eight seconds. A regular South Bend and Indianapolis service will soon be inaugurated with limited schedules. S.

YORK, PA.—A new trolley line will be built from Reisterstown to Hanover by way of Hamstead, Greenmount, Manchester and Melrose. The incorporators named in the charter are James H. Wilson, Jacob H. Sherman, Jacob A. Frederick, Newton S. Watts, John P. Bruns, Frank L. Hancock, Daniel F. Reisenweber, and William L. Deitrick. The line goes through Hamstead and Manchester in Carroll County, Maryland, thence extending into Pennsylvania. The capital stock of the corporation is $600,000, divided into six thousand shares, the par value of which is $100. O.

BELLEFONTAINE, OHIO.—It is reported that H. F. Houghton, general superintendent, and Earl Coston, division superintendent, of the Big Four Railway Company, are at the head of a promotion company which will build an electric line from Bellefontaine to Sidney. The line will touch Silver Lake Park, which has passed into the control of the Big Four, and will be extended by way of West Mansfield and Marysville into Columbus. The right of way has been purchased from the old Bellefontaine & Sidney Electric Railway company, and construction work will start next month. H.

CRAWFORDSVILLE, IND.—There has been a revival of the proposition to build an interurban railway from this city to Terre Haute and thence to St. Louis, via Newmarket, Balhinch, Alamo, Shades of Death and Waveland. A representative of a New York syndicate of promoters and builders of electric railroads recently completed an inspection of the route and was greatly impressed with the possibilities of a road built through the territory which is now without transportation of this kind. The syndicate has employed Samuel D. Symmes as its local agent and authorized him to proceed at once to secure the right of way. S.

SAN FRANCISCO, CAL.—The San Francisco Suburban Improvement Company, a corporation with $500,000 capital, will build an electric road in the Sunset District if the residents and others interested will subscribe the difference between the market and th par value of the bonds issued. The proposed route of the line would extend from Parnassus Avenue at the end of the Masonic Avenue carline to Third Avenue, to J Street, to Ninth Avenue, to Pacheco Street and Ninth Avenue, a distance of one and one-half

miles. The cost of the road is estimated at $80,000, of which sum the San Francisco Suburban Improvement Company has subscribed $60,000. A.

GREENVILLE, TEXAS.—At a meeting of the stockholders of the Eastern Texas Traction Company, held here, directors were chosen and the following officers elected: President, S. B. Perkins, first vice-president, J. H. Blocker; second vice-president, L. N. Byrd; third vice-president, J. H. Myrick; secretary, Joseph F. Nichols; treasurer, R. N. White. A committee was appointed to take immediate steps to obtain the right-of-way for the first twenty-one miles of the proposed system of interurban electric railway that the company will build between Greenville and Wolfe City. It is stated that the company has financed its project and that the construction work wil soon be started. D.

CANTON, O.—The Northern Ohio Traction and Light Company, operating the local street car lines and the interurban to Akron and New Philadelphia, will shortly begin the erection of a new central power station at a cost of $1,500,000. It is probable a site near Canton will be selected, as such a location would be near the center of the territory to be served. Either Canton or Akron will get the power plant. It depends upon the judgment of the force of experts who are examining the ground along the lines. The power house, it is said, will be the finest in the state and one of the best in the country. The entire Northern Ohio Traction system will be supplied with electricity from this plant and the present power houses will be utilized as substations.

FREDERICK, MD.—The directors of the Frederick Railroad Company, formed by the merging of the Frederick & Middletown and Braddock & Jefferson trolley systems and the Washington, Frederick & Gettysburg steam road, discussed electrifying the latter road recently, and held the matter under advisement. The directors authorized the purchase of the right of way from the Baltimore turnpike at the end of East Patrick street, through the property of the Frederick Improvement Company, to connect its Frederick & Middletown trolley line with the Washington, Frederick & Gettysburg road. A car barn and repair shops will be erected near the connecting point. William S. Taylor, who has been general manager of the new company since its formation, tendered his resignation, taking effect April 1. It is understood that George S. Anderson, the present superintendent, will take charge of the management of the road.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

WITTENBERG, WIS.—The Wittenberg Farmers Telephone Company, capital $3,010, has been organized. C.

CULBERTSON, MONT.—The Montana-Star Telephone Company is planning the completion of its line to Glasgow. C.

REPUBLICAN CITY, NEB.—The Farmers and Merchants Telephone Company has commenced the erection of a central office in this city. C.

BLACKCREEK, WIS.—The Blackcreek Telephone Company, Otto Rohm, secretary, has been organized to build six miles of line. C.

SPEARFISH, S. D.—The Spearfish-Redwater Telephone Company has commenced work on extending its lines through the valleys. C.

HAMILTON, MONT.—The Montana Independent Telephone Company has purchased a site for the erection of an exchange building to cost $15,000. C.

GRAND ISLAND, NEB.—The Nebraska Telephone Company has secured a site, forty-four by sixty-six, for the erection of a central office and headquarters building. C.

ARCHER'S FORK, O.—The Gorby-Cady Telephone Company has been incorporated with a capital of $10,000 by John Taylor and others. The company will do business in Washington County.

LAKE CITY, IOWA.—The Central Mutual Telephone Company has commenced the erection of an exchange building, which, with other improvements, will involve $20,000. C.

HENRICO, VA.—The Henrico and Charles City Telephone Company has been incorporated with a capital of $5,000. The officers are: H. S. Saunders, president, and A. F. Greeley, secretary and treasurer, both of Shirley, Va.

CLINT, TEXAS—The Clint Telephone Company has been organized here for the purpose of building a long distance telephone line to connect Clint with El Paso. The material for constructing twenty miles of line has been ordered. D.

MITCHELL, S. D.—The Dakota Central Telephone Company will receive bids up to noon, April 28, for the erection of a fireproof telephone building from plans by Fossum & Brown, architects, Aberdeen, S. D. check for two per cent. must accompany the bid. C.

CHERUBUSCO, IND.—Henry W. Soest has purchased the Cherubusco Telephone system for $30,000. The system consists of exchanges at Cherubusco, Huntertown, Green Center and Laotto. The new owner announces that he will extend the lines and greatly improve the plant. S.

BEAUMONT, TEX.—According to reports received here the Southwestern Telegraph and Telephone Company is planning important extensions of the telephone lines in the far western part of the state. Following the Santa Fe extensions, the telephone lines will be built to a large number of towns, with Lubbock as a basing point. The work will keep pace with the Santa Fe progress.

DEADWOOD, S. D.—Several improvements in the Black Hills telephone service were determined upon by officials of the Nebraska Telephone Company who have been inspecting their property in this section. The Deadwood-Lead service is to be improved with the addition of a cable; a metallic circuit is to be installed between Custer and Hot Springs; a line will be added to the service between Pierre and Rapid City with a copper circuit, and the system at Belle Fourche is to be reconstructed with the probability that the company will erect its own building there.

HOUSTON, TEX.—The final steps have been taken in the effort to establish the automatic telephone system in Houston, and the definite statement is made that the plant will be in operation by February 1, 1911. F. G. Reed and John S. Slusher, who have been promoting the enterprise for the past three years, have a contract under which F. E. Ebersole, of Omaha, is to take up the work of construction where Messrs. Reed and Slusher left off. The company is organized under the name of the Houston Home Telephone Company, with a capital stock of $1,000,000, and already has 5,000 subscribers on its books.

HOUSTON, TEXAS—The federal district court at Houston has appointed Max Taub as master commissioner under the final decree of that court authorizing the foreclosure of the mortgage and sale of the holdings of the Citizens' Telephone Company of Houston. The date of the proposed sale has not yet been announced by Mr. Taub. It will be made at public auction. The mortgage was given on January 1, 1901, to the International Trust Company, trustee, for the use of H. E. Huntington of Los Angeles, Cal., who was the instigator of the receivership proceedings. The outstanding bonds covered by the mortgage amounted to $266,000, which was accumulated interst now amounts to $312,217. D.

ELECTRICAL SECURITIES.

The weekly expectation of the settlement of the anti-trust cases has of late kept the stock market in repression. Now that these cases have been indefinitely postponed there was a violent riot in prices. The hesitation that followed was succeeded by a well-ordered and comprehensive rise. Opinion remained unaltered as to the importance of the questions at issue in the anti-trust cases, and an early determination of them would have been preferred, but it was concluded that financial and industrial activities were not likely to halt or even to hesitate during the long period of suspense likely to occur before the cases come to a decision. Numerous settlements of labor disputes were of good import and the universal advancing of wages carried with it belief in a coming upward revision of freight rates by the railroads.

There has been listed $671,000 additional consolidated mortgage bonds of the Wilkesbarre Gas and Electric Company on the Philadelphia Stock Exchange.

At a special meeting of the directors of the Third Avenue Railroad Company, Walter Haviland was elected president and William White, of Davies, Stone & Auerback, was elected secretary.

At the annual meeting of the Hudson and Manhattan Railroad Company, C. W. King and William H. Corbin were elected directors to succeed E. C. Converse, who resigned several months ago, and G. T. Rogers, who declined re-election.

Preferred shareholders of the United Railways of St. Louis have been requested by the company to exchange their certificates for new ones on account of the fact that the original issue did not exactly conform with the regulations of the New York Stock Exchange.

There have been listed on the New York Stock Exchange Pacific Telephone and Telegraph Company, $3,000,000 additional first mortgage and collateral trust thirty-year sinking fund five-per-cent bonds, due 1937, making the total amount listed to date $23,000,000.

DIVIDENDS.

American District Telegraph of New Jersey, quarterly dividend of one per cent, payable April 28.

Columbus (Ohio) Railway Company, quarterly dividend of one and one-quarter per cent, payable May 2.

Commonwealth Edison Company, quarterly dividend of one and one-half per cent, payable May 2.

Consolidated Gas, Electric Light and Power Company, of Baltimore, an initial semi-annual dividend of two per cent.

Electric Bond and Share Company, quarterly dividend of one and one-quarter per cent on preferred stock, payable May 2.

Edison Electric Illuminating Company, of Boston, regular quarterly dividend of two and one-half per cent and one-half of one per cent extra, payable May 2, to stock of record April 18.

Georgia Railway and Electric Company, preferred quarterly dividend of one and one-quarter per cent, payable April 20.

Havana Electric, preferred dividend of one and one-half per cent, and common dividend of one and one-half per cent, payable May 14.

Michigan State Telephone Company, quarterly dividend of one

and three-quarter per cent on the common stock, an increase of one-quarter of one per cent quarterly, payable June 1 to stock of record May 17; also the regular quarterly dividend of one and one-half per cent on the preferred stock, payable August 1 to stock of record July 16.

Railways Company General, regular quarterly dividend of one per cent, payable May 1 to stock of record April 20.

Tampa Electric Company, semi-annual dividend of four per cent, payable May 16.

United Electric Securities Company, regular semi-annual dividend of $3.50 per share on the preferred stock, payable May 2 to stock of record April 21.

NEW YORK.

	April 18.	April 11.
Allis-Chalmers common	11	10
Allis-Chalmers preferred	39	36
Amalgamated Copper	78⅜	72⅝
American Tel. & Cable	*80	*80
American Tel. & Tel.	137⅞	135
Brooklyn Rapid Transit	80¾	76¾
General Electric	152	149
Interborough-Metropolitan common	23¼	21⅝
Interborough-Metropolitan preferred	53⅞	56½
Kings County Electric	130	129
Mackay Companies (Postal Telegraph and Cables) com.	87	87
Mackay Companies (Postal Telegraph and Cables) pref.	76	76
Manhattan Elevated	136	134
Metropolitan Street Railway	18⅝	18⅝
U. S. Steel common	87⅞	82½
U. S. Steel preferred	122¼	119¼
Western Union	71¾	71
Westinghouse common	68	63¼
Westinghouse preferred	115	115

BOSTON.

	April 18.	April 11.
American Tel. & Tel.	137⅞	135
Edison Elec. Illuminating	256	255
General Electric	152	149
Massachusetts Electric common	19	17
Massachusetts Electric preferred	88	87
New England Telephone	134	*134
Western Tel. & Tel. common	14¾	15
Western Tel. & Tel. preferred	87	87

PHILADELPHIA.

	April 18.	April 11.
American Railways	45	45
Electric Company of America	11⅞	12
Electric Storage Battery common	62	60
Electric Storage Battery preferred	62	60
Philadelphia Electric	15½	15⅜
Philadelphia Rapid Transit	21¾	20⅞
Philadelphia Traction	86½	86½
Union Traction	49¾	49

CHICAGO.

	April 18.	April 11.
Chicago Railways, Series 1	98	97
Chicago Railways, Series 2	29	30
Chicago Subway	2½	3
Chicago Telephone	128	129½
Commonwealth Edison	115	115
Metropolitan Elevated common	15	15
Metropolitan Elevated preferred	52½	52
National Carbon common	112½	112½
National Carbon preferred	118	119

* Last price quoted.

LEGAL NOTES.

CARE REQUIRED OF TELEPHONE COMPANIES TO PREVENT INJURY FROM LIGHTNING.—Telephones, the court of appeals of Kentucky says, in Rural Home Telephone Company vs. Arnold, 119 S. W. R. 811, have been for many years in general use all over the country, and experience has pointed out the best methods and instrumentalities in their construction and equipment to prevent as nearly as practicable danger from lightning, and it is the duty of telephone companies in putting in and maintaining telephones to exercise reasonable care to construct them in such a manner and equip them with such known and approved appliances as careful and prudent men or companies engaged in the business consider reasonably necessary to prevent injury from this source. Whether it would be contributory negligence to use, or attempt to use, a telephone during a severe electrical storm, the court refrains from expressing an opinion.

TELEPHONE COMPANY NOT LIABLE FOR BURGLARS ENTERING HOUSE FROM POLE.—A telephone company having the legal right to erect a pole where it is placed, the court of appeals of Kentucky holds, in Jenkins vs. Louisville Home Telephone Co., 120 S. W. R. 276, that it will not be liable because of the fact that it enables burglars to enter a house, although the court suggests that in the case before it the company, as a matter of accommodation, ought to have placed the pole in question farther one way or the other so that one could not go from it into one of the windows of the house, provided it could have done so without detriment to itself. That the owner of the house notified the company of the anticipated dangers to herself and property did not deprive the company of its legal rights to use its property. Her duty was to take steps to protect her own property and herself from the anticipated dangers by making secure her windows.

SAFEGUARDING OF THIRD RAILS AGAINST TRESPASSERS NOT REQUIRED.—A company having the lawful right to install the third-rail system for the operation of its road, the supreme court of New Jersey holds, in Sutton vs. West Jersey & Seashore Railroad Company, 73 Atl. R. 256, that it is under no obligation to a trespasser, except to abstain from acts willfully injurious to him. It owes no duty to a trespasser upon its right of way of using care either to safeguard its third rail in such a way as to prevent him from coming in contact with it, or of giving him notice that such contact is dangerous to life and limb. To much the same effect, the United States circuit court, in Pennsylvania, holds, in Riedel vs. the same company, 170 Fed. R. 816, with reference to children trespassers. It says that the conceded dangers of the third rail may undoubtedly induce a legislature to require extraordinary precautions to be taken against injury therefrom, and it is no doubt true that, where the public is or is likely to be exposed to its perils, the companies that use it are obliged, even in the absence of legislation, to exercise care commensurate with the danger, but where a trespasser is injured, before the company can be held liable some breach of a legal obligation toward him must be shown. Primarily the defendant company owed a child the duty to exclude him from its right of way, or, what is perhaps a more accurate statement, it was bound to maintain the statutory fence.

PERSONAL MENTION.

E. F. KELLEY, from Sioux Falls, S. D., has been made manager of the Duluth, Minn., office of the Western Union Telegraph Company.

HARRY W. TURNER has resigned as manager of the Butte Electric and Power Company, of Butte, Mont., and has been succeeded by Max Hebgen.

C. A. CRANE, manager of the Duluth, Minn., office of the Western Union Telegraph Company, has been made manager of the St. Paul office.

W. R. CHAPMAN, St. Paul, Minn., superintendent of the Western Union telegraph office, has been appointed superintendent of the second district of the Western division of the company, with headquarters in St. Louis.

FRANK W. A. CAMPBELL, who has for the past five years been connected with the construction department of the General Electric Company, recently severed his connections with them to open a consulting and construction office at Houston, Tex. Mr. Campbell has with him a large force of expert mechanics.

A. MEINEMA, well known to the electrical trade in the middle west, and for some time past connected with the San Francisco sales force of the Electric Appliance Company of Chicago, has recently been made representative of the company for southern California, Arizona and New Mexico, with headquarters in Los Angeles.

JOHN C. PARKER, industrial engineer of the Rochester Railway and Light Company, addressed the salesmen of the Toronto Electric Light Company, Limited, at the Electric Building, 12 Adelaide Street East, on "Industrial Engineering," on April 15. Mr. Parker was in Toronto for the purpose of making an address before the local section of the American Institute Electrical Engineers and kindly consented to address the members of Mr. Creed's department.

JOHN H. WATERMAN has resigned from the Allis-Chalmers Company, to become general superintendent of the Light, Heat and Power Corporation, of Boston, Mass. This is a holding company, controlling twenty-two lighting and power plants supplying twenty-eight cities and towns in New England. Mr. Waterman has been connected with the Allis-Chalmers Company for a number of years, making his headquarters at the Boston offices, and more recently acting as sales engineer for the steam turbine department. He is one of the best informed men in the field, and his selection for this post is peculiarly fitting.

OBITUARY.

GEORGE GRIFFITHS STEEL, publicity manager of the Bell Telephone Company of Pennsylvania and controlled companies, and managing editor of the *Telephone News*, died April 11, at Pittsburg, Pa. Mr. Steel worked with the company for eleven years, rising by his own efforts to the position which he held at the time of his death. Pneumonia, which he contracted during a business trip to Pittsburg, was the cause of Mr. Steel's death.

EDGAR MEAD SMITH died April 9, at the residence of ex-Judge Daly, in Yonkers, N. Y. Mr. Smith's home was at the Seville, New York. Old age, combined with a recent attack of congestion of the lungs, caused his death. Mr. Smith was born at Islip, N. Y., in 1824. At the age of eighteen he began the study of law, but he abandoned the law for a mercantile career in New York. He was a member of the firm of Mitchell-Vance Company. He retired from business twenty years ago.

NEW INCORPORATIONS.

BUFFALO, N. Y.—The Electrolytic Products Company has been incorporated with a capital of $100,000 to manufacture automobile radiators. The directors are Mr. Abbott, Henry C. Steul and Joseph Porzel.

CHICAGO, ILL.—The States Electric Company has been incorporated with a capital of $5,000 to manufacture electric specialties. The incorporators are W. A. Bither, Frank T. Murray and J. A. Obermiller, all of Chicago.

GRAND RAPIDS, MICH.—The Truman M. Smith Company, electricians and machinists, have opened up a shop for the purpose of manufacturing vacuum cleaners of a new design. W. F. Monghler, of Toledo, is superintendent.

PROPOSALS.

STREET LIGHTING, RIDGWAY, PA.—Sealed bids will be received until May 4, for lighting the streets of Ridgway by electricity, to include approximately twelve 500-watt Mazda lamps and 600 fifty-watt Mazda lamps. All bids must be upon blank forms furnished by the borough and must be accompanied by a certified check for five hundred dollars made payable to The Borough of Ridgway.

POST OFFICE, CENTRALIA, ILL.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 18 for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office at Centralia, Ill., in accordance with the drawings and specifications, copies of which may be obtained from the custodian of site at Centralia, Ill., or at the Supervising Architect's office.

POST OFFICE, AUSTIN, MINN.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 9 for the construction complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Austin, Minn., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Austin, Minn., or at the supervising architect's office.

POST OFFICE, CLEVELAND, TENN.—The office of the Supervising Architect, Washington, D., will receive sealed proposals until May 6, 1910, for the construction (including plumbing gas fitting, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Cleveland, Tenn., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Cleveland, Tenn., or the supervising architect's office.

POST OFFICE, SHREVEPORT, LA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until May 16, for the construction (including plumbing, gas piping, heating apparatus electric conduits and wiring and standard clock system), of the United Post Office and Court House at Shreveport, La., in accordance with drawings and specification, copies of which may be had from the Custodian of site at Shreveport, La., or at the Supervising Architect's office.

POST OFFICE, OTTUMWA, IA.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until May 13, for the construction (including plumbing gas piping, heating apparatus, electric conduits and wiring and standard clock system) of the United States Post Office and Court House at Ottumwa, Iowa, in accordance with drawings and specification, copies of which may be obtained from the Custodian of site at Ottumwa, Iowa, or at the Supervising Architect's office.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date of Opening.	Material.	Quantity.	Delivery at Navy Yard.	Schedule No.
May 3.—	Boxes, water-tight	1,200	Brooklyn, N. Y.	2403
	Cable conductor, rubber insulated.	10,530 feet	Norfolk, Va.	2400
	Hangers, insulator	6,000	Brooklyn, N. Y.	2403
	Switches	107	Norfolk, Va.	2403
	Tubes, conduit terminal	2,050	Brooklyn, N. Y.	2403
	Wire, electric light	5,000 feet	Lake Denmark, N. J.	2406
	Wire, rubber covered	1,500 feet	Norfolk, Va.	2400

INDUSTRIAL ITEMS.

THE ELECTRIC MACHINERY COMPANY, Minneapolis, Minn., is mailing several flyers illustrating installation of its alternating current generators.

THE SAFETY INSULATED WIRE AND CABLE COMPANY, New York, N. Y., has been awarded a contract for laying conduit at railroad crossings in Toronto, Can. The amount of the contract is $11,387.08.

THE EDWARD E. CARY COMPANY of New York, N. Y., importers of "Fabius Henrion" carbons, "Cohesive" inner globes and other electrical supplies, announce that they have moved their office from 59-61 Park Place to 30 Church Street.

THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, Cleveland, O., is mailing a folder setting forth some reasons why Type G-2 controllers should be used. The folder shows several controllers and has an attractive design.

THE DEARBORN DRUG AND CHEMICAL WORKS, Chicago, Ill., announces that after May 1, their general offices and laboratory will be located on the twentieth floor of the McCormick Building, at the corner of Michigan Avenue and Van Buren Street. The extensive growth of business has made necessary a removal from the present offices in the Postal Telegraph Building.

THE GENERAL VEHICLE COMPANY, New York, N. Y., gives in its April number of Elec-Tricks, an interesting account of the use of G. V. Electrics in Manila. An illustration of the buffalo cart which appears at the front of the pamphlet, makes a striking contrast with an electric shown on the opposite page. Native Philippinos, the booklet states, are used almost entirely to drive the electrics.

EDWARD J. O'BEIRNE & CO., Elgin Ill., are mailing a booklet on the "Deflectolier," which it designates as "Something New, Interesting and Profitable" for managers of electric light plants. A number of illustrations of rooms lighted by tungsten lamps with deflectoliers are shown and many testimonials are reprinted.

THE DETROIT FUSE AND MANUFACTURING COMPANY, Detroit, Mich., in illustrated price list No. 15, gives prices on "Detroit" ironclad fused switches. The folder contains a description of the switch mechanism, and explains its good points. An illustration is shown of the "Engine House" type which are said to be "Fool Proof, Fire Proof, Fume Proof." This type is designed especially for use on railroads, docks, etc.

THE KERR TURBINE COMPANY, Wellsville, N. Y., has arranged for representation in two more American and three foreign cities as follows: San Francisco and Oakland, Cal., United Iron Works, London, Eng., Economical Gas Appliance Construction Co., Ltd.; Mexico City, J. H. Bloomberg; Sidney, N. S. W., A. F. Partridge. With the above the Kerr Turbine Company now has active representatives in twenty-six cities.

THE ELECTRICAL ALLOY COMPANY, Morristown, N. J., has recently opened its plant for the manufacture of eletrical resistance materials in the form of wire sheets and ribbons. The The alloys, which are made in Europe are especially imported for the company. A very interesting account of the process of manufacture together with a description of the plant appears in a recent number of the Morristown *Daily Record*.

HOWARD M. ELDRED, 817 Pabst Building, Milwaukee, Wis., manufacturers' representative, has ready for distribution "List No. 5," a booklet containing illustrations and descriptions of the electrical specialties he handles. These include Hagstrom spark plugs, cord adjusters and porcelain tube cutters; electric light attachments, Kolloid tungsten lamps; American inclosed arc lamps; Beyer time clocks; Anhydrous dry batteries; Allen-Bradley motor starters and crane controllers.

THE DELTA-STAR ELECTRIC COMPANY, Chicago, Ill., is distributing a twenty-page folder descriptive of a new protective system for use on series lighting circuits. The function of this new device is to automatically cut out a defective loop of the lighting system and at the same time keep in operation those parts of the system which are operative. Several diagrammatic drawings illustrate the application of this protective feature to commercial street lighting systems. Copies will be sent upon request.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces that it has just received orders for six machines as follows: Light, Heat and Power Corporation of Boston, a 1,000-kilowatt machine for its North Adams plant and a 500-kilowatt turbine for its Leominister plant; Manufacturers Power Company, of Woonsocket, R. I., a 1,200-kilowatt turbine; J. H. Ladew Company, of Newark, N. J., two 300-kilowatt machines and the Kleeb Lumber Company, of South Bend, Wash., one 500-kilowatt turbine.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., announces that it has ready for general distribution bulletin No. 1,110 describing its new types of telephone and signal apparatus for mines. The bulletin takes up the development of the Western Electric mine telephone and describes completely features of construction and operation of its two new types of sets—No. 336-E, a metal set, and No. 337-E, a wood set. Both of these new telephone sets are especially designed for underground service in mines. For use in the superintendent's office and in those protected parts of mining plants the No. 1.317 type Western Electric telephone set is shown. The bulletin consists of twelve eight by ten pages, with twelve half-tone illustrations of the sets and apparatus.

DATES AHEAD.

Arkansas Association Public Utilities Operators. Annual convention, Pine Bluff, Ark., April 27, 28 and 29.

Nebraska Electrical Association. Annual convention, Lincoln, Nebr., May 3, 4 and 5.

Southwestern Electrical and Gas Association. Annual meeting, Beaumont, Tex., May 10, 1910.

Ohio Mechanical, Electrical and Steam Engineers' Association. Next meeting, Cincinnati, Ohio, May 10.

Oklahoma Public Utilities Association. Next meeting, Sapulpa, Okla., May 9, 10 and 11.

Pacific Coast Electrical Exposition, San Francisco, Cal., May 21, 1910.

National Electric Light Association. Annual convention, St. Louis, Mo., May 23-28.

Maine Electrical Society. Next meeting, Portland, Me., May 25.

Mississippi Electric Association. Annual convention, Greenville, Miss., June 15 and 16.

American Institute of Electrical Engineers. Annual Convention, Waumbeck Hotel, Jefferson, N. H., June 27, 28, 29 and 30.

Michigan Electrical Association. Annual convention, Port Huron, Mich., August 16, 17 and 18.

Colorado Electric Light, Power and Railway Association. Next convention, Glenwood Springs, Colo., September 21, 22 and 23.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) April 12, 1910.

954,434. MEANS FOR SUPPRESSING THE RESISTANCE OF THE NEGATIVE-ELECTRODE FLAME IN ELECTRIC VAPOR APPARATUS. Peter C. Hewitt, New York, N. Y., assignor to Cooper Hewitt Electric Company. Filed March 21, 1902. A gas or vapor apparatus comprises a container, a positive electrode, a liquid negative electrode, and a solid electrode extension projecting above the surface of the negative electrode, the surface of the projection forming an oblique angle with reference to the surface of the liquid negative electrode.

954,445. TELEPHONE SYSTEM. Oscar M. Leich, Genoa, Ill., assignor to Cracraft-Leich Electric Company, Genoa, Ill. Filed Dec. 10, 1908. Repeating and impedance coils are included.

954,448. TERMINAL FOR PUSH-BUTTON ELECTRIC SWITCHES. Norman Marshall, West Newton, Mass., assignor to The Arrow Electric Company, Hartford, Conn. Filed Sept. 21, 1909. A terminal for an electric snap switch is formed of a single piece of conducting material and has a standard section with the ends thereof bent at right angles thereto, each of these ends having a perforation therethrough. A contact blade projects from one edge of the standard section in the plane thereof.

954,461. PUSH-SWITCH. Johann G. Peterson, Hartford, Conn., assignor to The Arrow Electric Company, Hartford, Conn. Filed April 28, 1909. An electric switch comprises a supporting frame, an arbor mounted in this frame, a rocker plate mounted on the arbor, a pole-carrying plate mounted on the arbor, a latch actuated by the rocker plate for holding and releasing the pole-carrying plate, a spring for throwing the pole-carrying plate when the latch releases this plate, a button frame removably connected with the supporting frame, buttons with key slots secured to the button frame, and key plates connected with the rocker plate in line with the key slots.

954,462. ELECTRIC SWITCH. Johann G. Peterson, Hartford, Conn., assignor to The Arrow Electric Company, Hartford, Conn. Filed May 18, 1909. A commutator for an electric switch comprises a supporting plate, a pair of yielding pole plates mounted thereon, and a yielding insulating disk mounted on the supporting plate above and below the pole plates.

954,463. ELECTRIC-SWITCH HANDLE. Johann G. Peterson, Hartford, Conn., assignor to The Arrow Electric Company, Hartford, Conn. Filed Aug. 31, 1909. A spring is inserted in a central aperture in the handle to work against the stem.

954,468. WINDING FOR ELECTRIC MACHINERY. Heinrich Rosenberg, Vienna, Austria-Hungary, and Emanuel Rosenberg, Berlin, Germany. Filed June 17, 1904. Renewed May 28, 1909. In combination with means for creating two magnetic fields, is a single armature acted upon by both fields, the first field being excited in a constant direction by a suitable current and weakened by a current flowing through the brushes appertaining to the second field, the second field being excited by a current produced by a rotating winding of the armature.

954,475. ELECTRIC LOCOMOTIVE. Frank L. Sessions, Columbus, Ohio, assignor to The Jeffery Manufacturing Company. Filed March 1, 1904. Describes a cable-reeling mechanism for an electric locomotive.

954,489. PRINTING-TELEGRAPH. John E. Wright, New York, N. Y. Filed May 14, 1907. Describes the receiver in detail.

954,493. DAMPER-REGULATOR. Cornelius Ambruster and Harold M. Beck, Chicago, Ill. Filed Jan. 12, 1906. Includes a thermostat, electromagnet, etc.

954,518. ALTERNATING-CURRENT TRANSFORMER. Herman A. Kelp, Rochester, N. Y., assignor to Electra Surgical Instrument Company, Rochester, N. Y. Filed Oct. 1, 1908. Comprises two insulators grooved on their opposed faces, a core arranged between them and seated in the grooves, tie rods connecting the insulators, a primary coil surrounding the core, a pair of contacts carried by one insulator and connected directly to the terminals of the primary coil, a secondary coil surrounding the core, a pair of conductor securing devices carried by the device and connected to the terminals of the secondary coil, and an open-ended cylinder engaging both insulators and inclosing the coils and the core.

954,537. ELECTRICAL CUT-OUT. Patrick J. McDonald, Rochester, N. Y., assignor of one-half to George H. Smith, Rochester, N. Y. Filed March 18, 1908. The insulating base has a bore therein, and a depression at one end of the bore. A contact is arranged within the bore and another within the depression and separated from the bore by the wall of the depression. A movable connector establishes electrical connection between the contacts.

954,596. INSULATOR. Albert L. Stadermann, Terre Haute, Ind. Filed Aug. 19, 1907. A cross-shaped insulator has tying grooves on all arms of the cross.

954,597. INSULATING DEVICE. Jan Steynis, Babylon, N. Y., assignor to Steynis Ozone Company. Filed March 29, 1909. An insulating device for fluid conduits comprises an insulating tube of electricity non-conducting material, a casing surrounding this tube, and means for supplying dry gas to the chamber formed by the casing.

954,599. ELECTRICAL SYSTEM OF DISTRIBUTION. William A. Turbayne, Lancaster, N. Y., assignor to Gould Storage Battery Company. Filed June 12, 1907. Two dynamos and suitable circuits and switching mechanism are arranged to connect a field winding of one dynamo in the circuit of the other dynamo or in a circuit of both dynamos in series. A battery excites one of the dynamos.

954,614. ARMATURE-WINDING. Frank Conrad, Swissdale, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed Nov. 3, 1906. A winding for a slotted armature core comprises a plurality of coils that are connected consecutively to adjacent commutator segments and are arranged in groups, all of the coils of each group being located in the same core slots, the conductors being connected, respectively, to the normally equal-potential terminals of the groups of coils.

954,619. INSTRUMENT FOR DETECTING ELECTRIC OSCILLATIONS. John A. Fleming, London, England, assignor to Marconi Wireless Telegraph Company of America, New York, N. Y. Filed Jan. 2, 1909. One electrode is of tungsten and the other of carbon.

954,640. APPARATUS FOR WIRELESS TELEGRAPHY. Guglielmo Marconi, London, England, assignor to Marconi Wireless Telegraph Company of America, New York, N. Y. Filed March 31, 1909. A wireless telegraph transmitter comprises two parallel disks, means for rapidly rotating the disks in opposite directions, studs equally spaced around the adjacent faces of the disks and an oscillation circuit connected to the disks.

954,641. WIRELESS TELEGRAPHY. Guglielmo Marconi, London, England, assignor to Marconi Wireless Telegraph Company of America, New York, N. Y. Filed May 15, 1909. A station for duplex wireless telegraphy includes a transmitter having a gap in the oscillation circuit, bridging pieces, means for very rapidly moving the bridging pieces in such manner that they bridge the gap at regular intervals, a receiver and means for rendering the receiver inoperative when the gap is bridged and rendering it operative when the gap is not bridged.

954,642. ELECTRIC RECEPTACLE. Norman Marshall, Newton, Mass., assignor to Marshall Electric Company, Portland, Me. Filed May 27, 1909. Describes in detail a socket attached to a base or wall plate.

954,656. ELECTRIC SIGNAL SYSTEM. Alfred L. Sohm, Los Angeles, Cal., assignor to National Electric Works, Inc., Los Angeles, Cal. Filed May 25, 1908. A signal-sending means at each outlying station consists of a wheel provided with teeth throughout the greater portion of its periphery, pins on the wheel corresponding in number to the number of prearranged signals, a movable contact member adapted for periodical engagement with each of the pins, a fixed contact member adapted to contact periodically with the movable contact member, etc.

954,682. ELECTROTHERMAL MEANS FOR PRODUCING MECHANICAL MOVEMENT. Abbot A. Low, Horseshoe, and Maurice J. Wohl and Harry Hertzberg, New York, N. Y., assignors to said Abbot A. Low, Horseshoe, N. Y.; said Maurice J. Wohl and said Harry Hertzberg, New York, N. Y., trustees. Filed April 21, 1908. A pair of thermally expansible wires stretched between supports are arranged to pull in opposite directions, the supports comprising a central support to which both of the wires are attached and to which a reciprocating movement is imparted by the alternate expansion and contraction of the wires. Supports are provided at the opposite ends of said wires and resilient members for holding the supports and wires in position, and means for alternately heating the wires.

954,689. DELAYED-ACTION ELECTRIC EXPLODER. Roland L. Oliver, Oakland, Cal., assignor to California Cap Company, San Francisco, Cal. Filed June 22, 1909. A breakable connection is provided between the circuit wires of the igniter and the casing, the parts being constructed and arranged to permit the connection to yield to the explosion of the primer to disconnect the wires from the casing.

954,697. SPARK-PLUG. Herbert F. Provandie, Boston, Mass., assignor of one-half to The Randall-Faichney Company, Boston, Mass. Filed May 24, 1909. A spark plug comprises an insulating body, spark points, a metallic stem supporting one of the spark points and having a sight opening extending longitudinally through the body of the plug, a light-transmitting parti-

tion which prevents the passage of gases through the opening, and means for detachably securing the partition to the plug.

954,701. AUTOMATIC TELEPHONE. James E. Rogers, Danbury, Conn., assignor to Frank H. Lee, Danbury, Conn. Filed Nov. 18, 1909. An automatic telephone comprises a hollow stem, spaced insulated circuit-changing contact springs suitably supported within the stem, a pair of arms pivoted to opposite sides of the stem, receiver telephones carried by the arms, a transmitter telephone supported by the stem, electrical connections between the main cable wires the contact springs the receivers and transmitter, and means operated by the spreading and contracting of the arms for respectively making and breaking talking connections.

954,714. SYNCHRONIZING ATTACHMENT FOR CLOCKS. Peter E. Burns, Syracuse, N. Y., assignor to Dey Time Register Company, Syracuse, N. Y. Filed Feb. 26, 1908. Includes an escapement arbor having a lug or tooth, a bifurcated lever having pallets arranged to engage the tooth alternately, a shaft on which the lever is mounted, an electromagnet arranged to actuate the lever, an adjustable stop arm in rigid connection with the lever, and a stop in the path of the arm.

954,716. CIRCUIT-CONTROLLER. Sewall Cabot, Brookline, Mass. Filed May 6, 1909. A circuit-controller has means for securing a plurality of practically equally spaced discharges of substantially the same potential in a sonorous circuit for each half-cycle of an alternating current associated with this circuit.

954,724. STARTER FOR ELECTRIC MOTORS. Karl von Dreger, Berlin, Germany. Filed July 11, 1908. Has braking features connected with the handle.

954,734. COMBINED TELEPHONE AND TELEGRAPH SYSTEM. George E. Hines, New York, N. Y., assignor of one-half to William T. Daley, Brooklyn, N. Y. Filed May 15, 1908. A combined telephone and telegraph system comprises a main conductor, telephonic apparatus connected therewith, means for impressing on the line telegraphic signals each due to a single induced electrical impulse of rounded wave form, and an impedance coil in series with the conductor and telegraphic apparatus and located between the telegraphic apparatus and the point at which the telephonic apparatus is connected successive impulses being of opposite direction.

954,745. ALTERNATING-CURRENT ELECTROMAGNET. Louis Larsen, New York, N. Y. Filed May 25, 1907. An electro-magnet coil is constructed for both voltage and cycles; a moving member is actuated thereby, and means are controlled by this member for varying the number of effective turns of the magnet coil.

954,804. INDUCTION-FURNACE. Karl A. F. Hiorth, Christiania, Norway. Filed Nov. 20, 1906. An induction furnace comprises an annular hearth, one or more bridges to decrease the sectional area of the annulus of the molten metallic charge, an electrode dipping into the slag only on each side of the bridge and a current conducting device between the electrodes to cause an electric current to pass from the metallic charge on one side of the bridge to the metallic charge on the other side of the bridge through the slag and electrodes.

954,808. ELECTRIC-FURNACE PRODUCT AND METHOD OF MAKING SAME. George N. Jeppson, Worcester, Mass., and Lewis E. Saunders, Niagara Falls, N. Y., assignors to Norton Company, Worcester, Mass. Filed March 26, 1909. The method consists in melting alumina substantially free from fluxing impurities, permitting the product to solidify into a crystalline mass, crushing and grading the same, and bonding the grains by a bond having sufficient strength to hold the grains until they fracture under conditions of use.

954,823. INCANDESCENT-LAMP SOCKET. Howard R. Sarent, Schenectady, N. Y., assignor to General Electric Company. Filed Aug. 20, 1908. A lamp socket comprises a rotatable screw-threaded contact provided with a radial shoulder, and a radially movable spring latch adapted to engage the shoulder, the latch comprising a resilient strip secured at one end of the base of the socket and extending lengthwise thereof.

954,827. ELECTRIC INDUCTION-FURNACE. Carl W. Soderberg, Ski, near Christiania, Norway. Filed May 15, 1909. Comprises an iron core, a hearth having an intermediate portion and semi-annular ends surrounding the portions of the core that pass through the hearth, a primary-coil system comprising two disk coils above the hearth surrounding those portions of the core extending through the hearth, the disk coils being in close proximity to the hearth and covering only the semi-annular portions of the bath in the hearth, thereby leaving the bath in the intermediate portion of the hearth open, and disk coils below the hearth also surrounding the core.

954,833. WIRE-PLATING MACHINE. George L. Wallace, Bridgeport, Conn. Filed Aug. 30, 1909. In combination with an electroplating tank are a series of continuously and uniformly operated drawing rolls, a series of continuously and uniformly operated shafts, a series of winding reels mounted upon the hubs of the shafts and adapted to slip and operate to conform to the movement of the wire from the drawing rolls.

954,838. MULTIPLE-FUSE HOLDER FOR SINGLE-POLE CIRCUITS. Horace Wheeler, Hartford, Conn., assignor to General Electric Company. Filed March 10, 1909. A multiple-fuse holder includes a casing having a combustion chamber, and a rotary carrier slidably mounted within the casing and provided with a series of fuses adapted to register with the combustion chamber.

954,842. COMBINED JUNCTION AND TERMINAL BOX FOR ELECTRIC WIRES. Frederick C. Woods, Galesburg, Ill. Filed June 14, 1907. Comprises a supporting bracket, a terminal box (secured thereto) provided with an enlarged central aperture in its upper portion, a sleeved connector secured to and above the box, and having communication with the aperture, there being an enlarged annular flange at its upper portion provided with series of apertures, and a dome secured to the flange, surmounting and surrounding it and its sides depending a distance therebelow, its lower portion being open whereby access may be had to the flange.

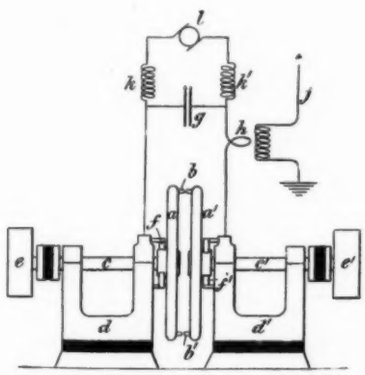
954,845. OVERLOAD PROTECTIVE DEVICE. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. Filed May 15, 1905. A protective device for a polyphase circuit includes a plurality of magnet windings supplied with current from the several phases of the circuit, independent switches controlled by the magnet windings and controlling the circuit, a single handle arranged to reset the switches simultaneously, and a spring normally holding the handle out of engagement with the switches.

954,872. TERMINAL FOR ELECTRIC WIRES. Arthur R. Mosler, New York, N. Y., assignor to A. R. Mosler & Co., New York, N. Y. Filed Nov. 19, 1908. A terminal has a plurality of fingers of elastic material for automatically attaching the terminal to a spark plug, one of the fingers being provided with means for locking the terminal to the plug.

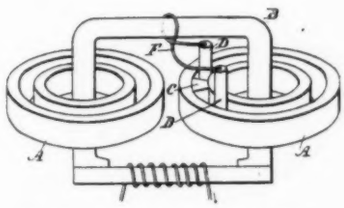
954,878. ELECTRIC LAMP. Roger M. Newbold, Chicago, Ill., assignor to The Adams & Westlake Company. Filed May 21, 1909. Comprises a reflector, a lamp mounted in connection with the reflector, and electromagnetic means for adjusting one of said elements with reference to the other.

954,888. CONTINUOUS-WIRE-DRAWING MACHINERY. Harry Saville, Cleckheaton, England, assignor to The British Steel and Wire Company, Limited, Manchester, England. Filed Aug.

954,731.—APPLIANCE FOR MERCURY-VAPOR LAMPS.



954,640.—APPARATUS FOR WIRELESS TELEGRAPHY.



954,804.—INDUCTION FURNACE.

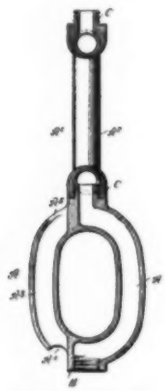
14, 1909. In combination with the dies and drums are electric motors for rotating such drums, switches for controlling the motors, and means whereby the pull exerted upon the wire by one drum controls the speed of the electric motor by which the preceding drum is driven.

954,907. AUTOMATIC SAFETY DEVICE FOR TROLLEY-POLES. Mahlon M. Zellers, Belleville, Ill. Filed Jan. 18, 1909. A trolley safety mechanism includes a pole and means to hold the pole at work comprising a stand and rods mounted thereon, two separate cross heads on the rods and springs between the same on the rods, toggle-link connections between the pole and one of the cross heads and the stand and connecting rods between the other of the cross heads and the base of the trolley pole, whereby the tension of the springs is exerted to hold the trolley pole raised and the collapse of the toggle-links permits the pole to drop.

954,931. RECEIVER FOR SOUND-TRANSMITTING INSTRUMENTS. John J. Comer, Santa Monica, Cal., assignor to George R. Webb, Baltimore, Md. Filed March 4, 1907. A receiver comprises a diaphragm, an electromagnet, an armature having a bearing on one pole of the magnet and carrying a lever one end of which is connected with the diaphragm to move it both back and forth.

954,954. CONNECTION-BOX FOR ELECTRIC CONDUITS. John E. Graybill, York, Pa. Filed May 15, 1907. A junction box for electric wire conduits comprises a plurality of separable longitudinal sections, and quick release ring-like clamping means, the clamping means and box having interengaging surfaces oppositely inclined at such an angle that a partial rotation of the clamping means will clamp the sections together.

954,963. LOCK-GUARD FOR INCANDESCENT LAMPS AND SOCKETS. Harvey Hubbell, Bridgeport, Conn. Filed Dec. 13, 1909. A guard for incandescent lamps and sockets comprises



955,002.—COMBINED GAS AND ELECTRIC FIXTURE.

a rigid cage, a locking plate to which the cage is secured and which is adapted to engage a lamp socket cap and a centering plate adapted to pass within the cage and having a central hole to receive the socket.

954,997. RECORDING-TARGET. James W. Rice, Wellsville, Ohio. Filed March 1, 1909. An annunciator has electrical connections with the pivotally supported target sections.

955,002. COMBINED GAS AND ELECTRIC FIXTURE. Abraham I. Schwinger, New York, N. Y., assignor of one-third to Solomon Schulein and one-third to Simon Braunstein, New York, N. Y. Filed July 21, 1909. A combined gas and electric fixture comprises a plurality of hollow links joined with each other at their ends, the links forming a continuous passage for gas and an interrupted passage for electric wires.

955,035. PUSH-SWITCH. Carl E. Anderson, Bridgeport, Conn., assignor to The Perkins Electric Switch Manufacturing Company, Bridgeport, Conn. Filed Oct. 27, 1909. A switch mechanism comprises a switch member, a rocker and means controlled by the latter for imparting a sudden oscillation to the former, and flanges on the rocker forming sliding bearings for an actuating push member.

955,056. COMBINED TELEPHONE AND FIRE-ALARM OR KINDRED SERVICE SYSTEM. William W. Dean, Chicago, Ill., assignor to Consolidated Fire Alarm Company, New York. Filed Aug. 15, 1903. In combination with a telephone line are auxiliary signaling apparatus adapted to send signaling currents of high frequency over the line, and an alarm signal-receiving apparatus including a relay of high self-induction and a condenser of small capacity in the bridge of the line, both adjusted so as to be substantially resonant to the signaling currents, but impassable for steady currents or low-frequency alternating currents and opaque to voice currents.

955,058. CIGAR-LIGHTER. Christian Dinger, Sparta, Wis. Filed May 26, 1909. An electric spark lights a wick connecting with a gasoline chamber.

955,059. AUTOMATIC TRAIN-STOP. Sidney M. Duncan, Eastend, Tenn., assignor of one-half to Sim M. Blaylock, Eastend, Tenn. Filed June 28, 1909. The locomotive has a valve for controlling the supply of steam to the cylinders thereof, a pneumatic device for operating the valve, a valve-controlling communication between the air-brake system and the pneumatic device, a brake-applying valve and electrical means for simultaneously opening both valves.

955,065. INSULATOR. Cornelius C. Hardin, La Fayette, Ga. Filed July 22, 1909. An insulator comprises a stem having clamping means at one end for receiving and holding a plurality of conductors and an insulating block in which the other end of the stem is anchored.

955,089. ELECTRIC VENTILATOR. Wilhelm Mehlhose, Charlottenburg, Germany. Filed April 29, 1908. In combination with a support are a fan mounted on the support to turn and having a bell around its nave, a cased electromotor adapted to rock in the bell of the fan around an axis at right angles to its armature shaft, means adjusting the electromotor in any angular position with regard to the fan, and a second fan fastened on the armature shaft of the electromotor, so that it is adapted to rotate in one direction, while the casing of the electromotor being at liberty to move is adapted to drive the fan in the opposite direction with the component of its tangential force.

955,101. SPARK-GAP APPARATUS. Wilhelm Peukert, Brunswick, Germany. Filed May 14, 1909. A spark-gap apparatus comprises a stationary terminal, an extended vertical metallic terminal in close proximity thereto, means for rotating the latter terminal and means to supply by gravity a dielectric liquid to the rotating terminal and gap.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (furnished by the United States Patent Office) that expired April 18, 1910:

495,538. DYNAMO-ELECTRIC MACHINE. Thomas L. Willson, Brooklyn, N. Y.

495,547. COMBINED ELECTRIC MOTOR AND DRIVEN MACHINE. Rodolphus Fuller, Detroit, Mich.

495,552. INSULATOR. Louis Hills, New York, N. Y.

495,561. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES OR MOTORS. Buchanan S. Paterson, Gateshead, England.

495,562. FIELD-MAGNET. Frank A. Perret, Springfield, Mass.

495,582. GROUND GENERATOR OF ELECTRICITY. Michael Emme, Oakland, Cal.

495,587. SHIP'S LOG. Charles F. Holt, New London, Conn.

495,600. ELECTROLYTIC APPARATUS. Gustaf O. Rennerfelt, Stockholm, Sweden.

495,601. ELECTRIC-ARC LAMP. Frederick T. Schmidt, Bradford, England.

495,615. CROSS-OVER SWITCH FOR ELECTRIC RAILWAYS. Frank B. Rae, Detroit, Mich.

495,620. INCANDESCENT ELECTRIC LAMP. Eugene W. Applegate, Chicago, Ill.

495,626. ELECTRIC WELDER FOR WIRE-FENCE MACHINES. John D. Curtis, Worcester, Mass.

495,638. SECONDARY BATTERY. Leslie B. Rowley, Ashland, Wis.

495,643. ELECTRIC-ARC LAMP. William A. Turbayne, Detroit, Mich.

495,649. ELECTRIC-ARC LAMP. Charles F. Adams, Morrison, Ill.

495,674. RAIL-CIRCUIT-CLOSING CONTACT. Friedrich von Hefner-Alteneck, Berlin, Germany.

495,676. ELECTRIC LAMP. Tobias Hudson, Baltimore, Md.

495,695. ELECTRIC-RAILWAY TROLLEY. William Duncan, Allegheny, Pa.

495,714. LIGHTNING-ARRESTER. Lynn, Mass.

495,738. ELECTRIC ROTARY DRILLING MACHINE. Robert M. Jones, Salt Lake City, Utah.

495,770. TIME-INDICATOR AND SIGNAL FOR RACES. Alfred Bartlett, Auckland, New Zealand.

495,772. ELECTRIC ARC LAMP. Ernest E. Beauvalet and Leon C. Beauvalet, Paris, France.

495,782. ELECTRIC SHOE-SOLE. Rufus F. Carnes, Winfield, Ala.

495,853. LIGHTNING-ARRESTER. Elihu Thomson, Swampscott, Mass.

495,861. ELECTRIC BELT. George F. Webb, Cleveland, Ohio.

495,913. DANGER-SIGNAL FOR RAILWAY-CROSSINGS. James S. Savage, Jr., Detroit, Mich.

495,929. ELECTRIC CIGAR-LIGHTER. William Carter and Charles E. Wiley, Louisville, Ky.

495,932. ELECTRIC-LIGHTING SYSTEM. Henry Edmunds, Jr., London, Eng.

495,940. ELECTRIC TROLLEY. Jeannot W. Kenevel, Chicago, Ill.

495,941. ELECTRIC MOTOR OR GENERATOR. William Koedding, St. Louis, Mo.

495,951. INCANDESCENT ELECTRIC-LAMP HOLDER. Leroy C. Whitney, Jr., Milwaukee, Wis.